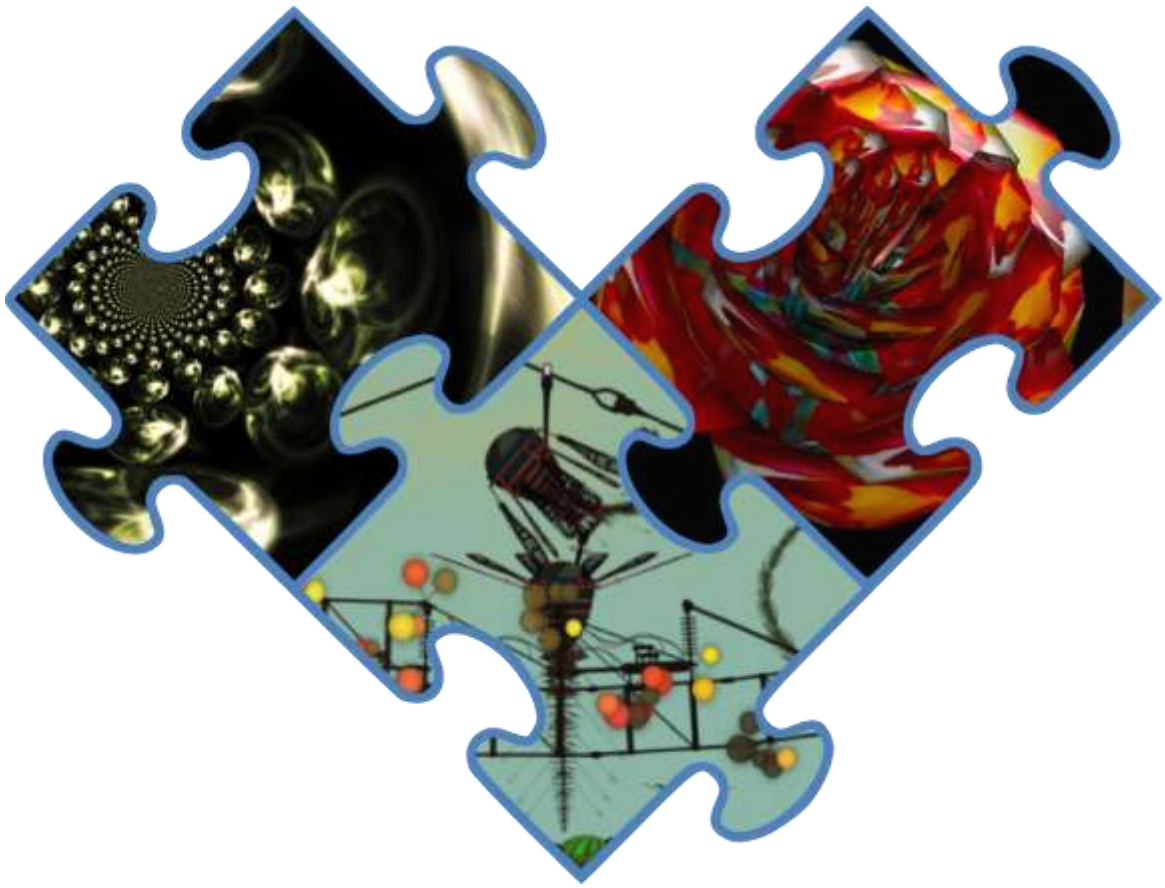
The Preservation of Complex Objects

Volume 2

Software Art



2012

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JISC

The Preservation of Complex Objects

Series editors:
David Anderson, Janet Delve, Milena Dobreva

Volume 2. Software Art

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Published by the JISC.

ISBN 978-1-86137-6312

First published November 2012.

Preface

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It is a pleasure to be invited to offer a short preface to this second volume in the POCOS series.

POCOS is an outward-looking and thoughtful project which addresses topics of significant complexity for the preservation of digital collections. Preservation is challenging enough for relatively well-understood and self-contained data types like images and documents but the digital estate is increasingly about sophisticated interactions and interdependencies between software, hardware and people. Our digital memory is growing in scale, our interactions with it are growing more sophisticated, and the ways in which elements are constructed are growing ever more subtle. So the challenge is not necessarily getting easier the more we know about it. Those concerned with safeguarding our digital legacy must never fall into the trap of constraining digital creativity - but nor should they be so complacent as to think they can afford to ignore change. Instead of waiting for inspiration to come through introspection or individual genius, POCOS invited, persuaded and cajoled many people to consider the transience of our digital heritage. Three symposia followed, on broad themes of visualisation, software art and virtual worlds. Creators, policy makers, conservators and collection managers shared their aspirations, expectations, priorities and limitations. The resulting reports will become a lasting contribution - perhaps even a roadmap - for research and development. Although those behind it would never be so grand to claim it themselves, it has all the best elements of a 'grand challenges' initiative.

This volume considers the preservation of software art. At first inspection, preservation of software art may seem like an esoteric concern for ephemeral objects. But, as with all of POCOS, it challenges many of our expectations about collection management and preservation. There are complex technical challenges about the interdependencies of software, operating systems, hardware and users. It introduces the inter-subjectivity of meaning and the contexts of performance which defy simplistic approaches to documentation and representation. It crosses the boundaries of institutional genre and raises disconcerting questions about policy and competence. So there is a real sense that software art is a topic for the avant-garde of digital preservation: it pushes the boundaries not for its own sake but in order that all can progress,

It was appropriate that the POCOS symposium on software art should assemble at The Lighthouse in Glasgow. Formerly the home to the Glasgow Herald newspaper, The Lighthouse was designed by John Keppie whose able apprentice - Charles Rennie Mackintosh - has created an enduring legacy of innovation in design in the City. But the venue did not simply cause participants to consider excellence in design: in his welcoming remarks Mark O'Neill made explicit the connection between cultural enterprise, heritage and regeneration, introducing as he did so the relationship between culture, well-being and the economy. Glasgow has spent 18 million pounds on new storage for its museum collections in the last decade: ensuring its protection but also making it available for new kinds of creativity and ensuring that this vast asset is an active contributor to the city's economy. Impact, he noted, follows from visionary alliances and well-developed infrastructures and a determined effort to understand

cultural assets and deploying them to best advantage. All of this underlines the point that discussions are not whimsical or abstruse: cultural and creative infrastructures, such as those needed for the preservation of software art, bring opportunities and impact.

This volume introduces some of the papers from the symposium and it extends in written form many of the lively discussions that they provoked.

Janet Delve provides an overview of developments before, during and since the symposium, while Leo Konstantelos looks at documenting the context of software artworks through social theory. Simon Biggs, an art historian working with software art, observes that for several decades now, redundancy has not been an unhappy coincidence. On the contrary, for some it has become part of a creative strategy and even a creative force for artists who have questioned permanence. In some cases transience is a deliberate attempt to subvert the art market or simplistic notions of value. So, crudely applied, preservation actions may flout the creative process. On the antipode, Perla Innocenti discusses issues of authenticity, longevity and collaboration in preserving digital art from an interdisciplinary perspective, explaining how embracing variability in preservation approaches can match the intrinsic variability and dynamic authenticity of digital arts.

Interaction amplifies the preservation challenge, especially when it comes to setting the extents of any preservation plan. Daisy Abbott observes that interaction is at the core of much software art, and therefore there is no canonical form to be preserved as there might be with a data set or a document. Michael Takeo Magruder extends this by introducing art that takes real-time data and turns these into dynamic and constantly changing representations. In this context the software is only one part of an installation which is embedded in many other components, has sophisticated inter-dependencies, sometimes in distributed sources. The extents of preservation actions necessary to protect such an art work are unclear. Vicky Isley and Paul Smith go further and note that the interactions and interdependences are not always planned and not always obvious at the point of creation. For example, moving software from one processor to another can change the temporal performance of an art work dramatically. Therefore running the software on modern computing is only possible with a kind of time signature so that it works effectively. Better choices and planning can remove some of these dependencies - such as use of open source software - but by no means all. Collecting and commissioning institutions have been slow to recognise the range of information that they need to collect from artists, and artists have not always understood the ramifications of the tools they have chosen to use.

In sharing the presentations from the symposium, the authors have also been keen to capture the discussions that went with them. Key themes emerged which are likely to be debated on an ongoing basis. For example, the artist has a key role in helping to shape the preservation plan for an artwork, and providing appropriate information to ensure longevity: but they are not likely to want to keep being drawn back into preserving old work. Cultural institutions have a role for preservation and access as they have always had, but these will need to change dramatically in practical application. The documentation of art will also remain a key concern for the collecting institutions, but in the digital age this is more than a few notes about provenance or biographical notes of the artist and the works. All of this implies a series of legal, ethical and professional undertaking to frame the new types of relationship between artist, institution and public. Each of these issues was explored in lively discussion sessions, and each has been presented here in written form.

This volume feels its way towards a preservation strategy for software art. It is unlikely that this will be the final word on the topic - indeed my hope is that it has the effect of provoking rather than resolving. Disagreement, discussion, and dissection are not weaknesses when we come to address grand challenges.

Let me end this preface by offering a measure of success with which readers can assess the POCOS symposia and this volume in particular. POCOS presents a grand challenge and it has given us many of the materials needed to meet it. This volume will be quoted as the most useful work of its kind within a year of publication. If it is still quoted as such in five years then the organisers have done something right. If it is quoted as the most useful work on the topic in ten years then something has gone wrong. Even in digital preservation, obsolescence can be a measure of success.

Acknowledgements

Preservation Of Complex Objects Symposia (POCOS) has been funded by the JISC Information Environment Programme 2009-11.

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Introduction to POCOS e-Book 2: Preserving Software Art

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Background to POCOS

The preservation of complex materials and associated environments presents the Digital Preservation (DP) community in general, and the JISC community in particular, with considerable intellectual and logistical challenges. While many of the techniques that have been developed within the context of migration-based DP approaches are of continuing value, others cannot be applied so well given the extra complexity presented by, for example, interactive videogames. Recent work undertaken in the Planets and KEEP projects has shown that the problems involved in preserving such materials and their associated environments, while substantial, are by no means intractable. However, in order to continue to make progress in this area it is important to engage and energize the wider DP community. A vital aspect of this process comprises articulation of the state of the art in 1. Simulations and Visualisations; 2. Software Art and 3. Gaming Environments and Virtual Worlds. This encompasses exploring with international experts the research results achieved so far across each of these domains; presenting coherent pathfinder solutions; and clearly signposting areas where work remains to be done. A further step is to synthesize key findings across all three areas and emphasize synergies that can be built upon, and to disseminate these to the various stakeholder communities.
These are the principal objectives that POCOS addresses and POCOS partners are well-placed to tackle the problem space, with the University of Portsmouth as overall coordinator bringing research and technical input from KEEP; the British Library supplying project management and research expertise from Planets, King's Virtualisation Laboratory bringing their specialist visualisation and simulation knowledge and experience and The Humanities Advanced Technology & Information Institute giving their specialist Software Art expertise from Planets. Joguin sas were involved in the first two symposia to which they contributed graphical input to the booklets as well as technical experience from KEEP.

So, in a series of three symposia presented across the UK:

- *Simulations and Visualisations* organized by the Kings Virtualisation Laboratory (KVL) at Kings College London on June 16th and 17th 2011;
- *Software Art* organized by The Humanities Advanced Technology & Information Institute (HATII), the University of Glasgow, at the Lighthouse, Glasgow on October 11th and 12th 2011; and
- *Gaming Environments and Virtual Worlds* organized by the Future Proof Computing Group, the University of Portsmouth at the Novotel Hotel, Cardiff on January 26th and 27th 2012;

POCOS brings together the leading researchers and practitioners in each field to present their findings, identify key unsolved problems, and map out the future research agenda

for the preservation of complex digital materials and their related environments. The fundamental task to be faced during these symposia lies in presenting specialist material of great technological, organizational and semantic complexity in a lucid, cogent, relevant and approachable manner so as to engage UK HEI researchers and practitioners in a wide variety of disciplines, as well as reaching those further afield in, for example, commerce, industry, cinema, government, games and films classification boards, and healthcare. There is the added concern that the specialists in each field may not necessarily be aware of general trends in DP, and vice versa. Similarly, any differences in terminology might need careful addressing. Clarity of expression and good communication is thus paramount throughout all the exchanges and discussions.

To this end, there is a series of three e-books, one for each symposium output plus any additional salient material, available from the POCOS website[1]. There is also a final compendium book covering all three symposia, together with a set of pathfinder solutions. This e-book is the second of the three, and continues the discussion of complex digital objects in the context of software art.

The nature of a complex (digital) object

An essential first step when considering the nature of complex digital objects is to recognize that there are multiple layers of difficulty encountered when attempting to analyze them. These layers could be superficially likened to Georg Cantor's "levels of infinity" in terms of mapping out the size of the problem space to be analyzed. The first "level of infinity"[2] is that of detail: the problem of drilling down through many layers of technical elements, showing levels of interconnectedness both within digital objects themselves, and also with their technical environments. An example of such a challenge is that of preserving software art and video games under binary translation and virtualization carried out by (Konstantelos, 2010) under the aegis of the EC Planets project[3] where running interactive digital art under emulation and virtualization was examined in depth and scientific experiments conducted within the Planets Testbed environment. Similarly, preserving video games under emulation was the subject of a broad, systematic, in-depth study in the EC KEEP project[4] (Pinchbeck *et al.*, 2009).

Analyzing and mapping such a great level of detail is not just confined to emulation, virtualization and binary translation. The migration community has responded to the task of recording each aspect of a complex digital object by developing ontologies of significant properties, and the Planets project played an important role in both conducting and disseminating this research (Dappert & Farquhar, 2009). However, significant properties under migration encompasses not only the "level of infinity" concerning detail, but also another one to do with scale. Emulation also addresses the issue of scale as in practice it necessitates mapping out the necessary hardware, software, middleware etc. that makes up the technical environment of each complex digital object. The characterisation work in Planets (Thaller, 2009), and technical environment modelling activity in KEEP thus represent important aspects of the state of the art in this problem

[1] http://www.pocos.org/index.php/publications
[2] Developed at the end of the nineteenth century.
[3] http://www.planets-project.eu/
[4] http://www.keep-project.eu/ezpub2/index.php Keeping Emulation Environments Portable (KEEP) is a medium-scale research project which started on 1 February 2009 and is co-financed by the EC's 7th Framework Programme (ICT-3-4.3 Digital libraries and technology-enhanced learning priority).

space, and have provided a firm foundation from which to develop the area. So, from this springboard, how do we start to tackle the task of analyzing the complex digital object *per se*?

The notion of the digital object is a mainstay of everyday life in mainstream digital preservation: indeed it is a concept that is fundamental to the way we approach this whole domain using OAIS (CCSDS, 2009), PREMIS (OCLC/RLG, 2008) etc. Now, we can categorise an object as being atomic or complex: for example Hunter and Choudhury refer to "atomic or composite mixed-media digital objects" (Hunter & Choudhury, 2006, p. 175). Another reference to complex digital objects comes from Somaya Langley[5] at the National Library of Australia's Gateway, who visited California in 2006 to study aspects of this subject area in three institutions (and incidentally came across the Media Art Notation System[6] that features heavily in this e-book). But it is really possible to separate digital objects into atomic and complex?

Let us say that there is an implication that an atomic digital object is a single file, and that this is synonymous with the notion of simplicity. But is that really the case? A single pdf file is often put forward as an exemplar of such a straightforward file, but the recent pdf 2.0 version can contain embedded 3D objects, so can it really be considered as 'atomic' and 'simple'? So it might be a somewhat daunting task to rigidly categorize digital material past, present and future as either atomic or complex. During the symposia, the POCOS strategy was not to seek to impose definitions or standards on the proceedings, but rather to see whether any consensus emerged during the talks and breakout sessions. So given that general standpoint, how are complex objects regarded in terms of *Software Art*?

The Nature of Software Art

First it is important to note that Software Art, (and Gaming Environments and Virtual Worlds), are each cognate disciplines in their own right: *Software Art* has dedicated artists, museums, techniques and commissioning procedures; and *Gaming Environments and Virtual Worlds* have their own games developers, games museums, conferences for the gaming community, fan websites etc. *Simulations and Visualisations*, on the other hand, are in a somewhat different category, comprising as they do amorphous techniques / outputs that are used in many different areas of digital representation.

The definitions of complex digital objects given above were in the context of purely born-digital material. A critical issue for Software Art is the fact that many of the artworks are *composite: being part physical and part digital: hybrid digital objects*[7], thus compounding the tasks for the DP community to take into account. For example, a software artwork may be based on the movement of live snails (and this work has a truly long shelf life), or on the fluctuations of the stock exchange. So the work comprises complex elements linked together by mathematical / physical calculations, all of which must be meticulously preserved to retain the cultural / technological context of the work. A consideration that is unique for Software Art is the value aspect. Since there is no distinction between master copies and any others in Software Art, the problem of a museum commissioning and preserving THE artwork is contentious, to say the least. It is

[5] http://www.nla.gov.au/pub/gateways/issues/84/story05.html
[6] See (Rinehart, 2007)
[7] See (Thomas, 2007) for a discussion of hybrid digital objects in the context of personal archiving.

clear that artist, technology provider and curator need to work together right from the earliest moments of a commissioned software artwork's life to ensure that steps are in place for its long term preservation.

Links to the Next Book

The first e-book is on Preserving Visualisations and Simulations and involves some current issues such as preserving 3D models as well as hybrid digital objects in an archaeological context. The third e-book is on Preserving Gaming Environments and Virtual Worlds. Details will be made available on the website when this is published: http://www.pocos.org/index.php/publications

References

CCSDS. (2009). Reference Model for an Open Archival Information System (OAIS). Washington: NASA.

Dappert, A., & Farquhar, A. (2009). Significance Is in the Eye of the Stakeholder. Paper presented at the ECDL2009. http://www.planets-project.eu/docs/papers/Dappert_Significant_Characteristics_ECDL2009.pdf

Hunter, J., & Choudhury, S. (2006). Panic: An Integrated Approach to the Preservation of Composite Digital Objects Using Semantic Web Services. International Journal on Digital Libraries, 6(2), 174-183. doi: 10.1007/s00799-005-0134-z

Konstantelos, L. (2010). Preservation of Dynamic & Interactive Content by Use of Binary Translation and Virtualisation – a Methodology for Experimentation Planets Project Report (pp. 106): HATII, University of Glasgow.

OCLC/RLG. (2008). PREMIS Data Dictionary for Preservation Metadata Version 2.0 (pp. 224). Retrieved from http://www.loc.gov/standards/premis/v2/premis-dd-2-0.pdf

Pinchbeck, D., Anderson, D., Delve, J., Ciuffreda, A., Alemu, G., & Lange, A. (2009). Emulation as a Strategy for the Preservation of Games: The Keep Project: Breaking New Ground: Innovation in Games, Play, Practice and Theory. Paper presented at the DiGRA2009, Brunel University.

Rinehart, R. (2007). The Media Art Notation System: Documenting and Preserving Digital/Media Art. Leonardo, 40(2), 181-187.

Thaller, M. (2009). The Extensible Characterisation Languages - XCL. Hamburg: Verlag Dr. Kovac.

Thomas, S. (2007). Paradigm: A Practical Approach to the Preservation of Personal Digital Archives (pp. 42). Retrieved from http://www.paradigm.ac.uk/projectdocs/jiscreports/ParadigmFinalReportv1.pdf

Make or Break?
Concerning the Value of Redundancy as a Creative Strategy

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Introduction

There is a contradiction at the heart of digital art making, regarding its temporal mediality and relationship with a mainstream visual arts practice that values permanence. Why do we wish to preserve something temporal and fleeting? Will the preservation of digital works contribute to a process of commodification that many media artists have sought to avoid by embracing the ephemeral nature of digital media? Are there reasons that would justify preserving digital works of art when, for some artists, redundancy is a key principle in their practice?

A Cultural Determinacy?

Art is generally valued according to a set of established criteria that include authenticity, originality, craft skill, uniqueness, rarity, provenance and its state of preservation. Modernist artists, as early as Dada but more often since, have sought to question or overturn these criteria and establish alternate value systems, where mass production, appropriation, temporality, decay and transience are fore-grounded. Established artists as diverse as Tristan Tzara, Kurt Schwitters, Andy Warhol, Judy Chicago, Donald Judd, Robert Smithson, Joseph Beuys, Carolee Schneeman and Nam June Paik have, through various strategies of production, contextualisation and mediation, proffered alternative models of artistic value.

Smithson's Spiral Jetty stands as an emblematic work in this regard - unownable, more or less impossible to preserve, being subject to the vagaries of its environment, produced employing heavy earth moving equipment and regularly transformed through natural weathering and chemical processes, perhaps the only conventional criteria of value such a work sustains is its singularity and thus rarity value. Spiral Jetty stands as one of the iconic post-war American art works, a touchstone for generations of artists since, probably because it breaches so many of the established values we conventionally associate with art objects.

The digital arts share many characteristics with work like Smithson's. The digital and media arts have their roots in 1970's post-modern culture - the first generation of media artists, including Robert Breer (recently deceased), Pauline Oliveros, Stan van der Beek, the Whitney's, Paik and many others, often members of Fluxus, emerged during the 1960's and were central to an artistic culture that would prove influential beyond its domain, feeding into conventional visual art practices as well as other disciplines, such as music, literature and performance, and facilitating the emergence of novel art forms. These artists focused on process and action, not craft and the final artefact. They were, admittedly, often obsessive in their use of materials, but they generally avoided fetishistic

strategies, often choosing the abject and quotidian over the rare and rarefied. Many of these artists used materials that, by their nature, could not be preserved. Their rationale for such choices was not just aesthetic but often socio-economic.

A second generation of digital artists can trace their origins to this same cultural milieu. Larry Cuba, Jeffrey Shaw, Roy Ascott and others have produced works that employ media platforms that are by their nature unstable and unfixed, focusing value on transience and momentary experience. For these artists the attraction of digital media was not just the potential of such systems and tools, or how these systems allowed reflection upon what was rapidly becoming a mediatised culture, but also the innately fleeting character of the art works and experiences that could be produced. Their artistic rationale was to circumvent the traditional values of the visual arts and, especially, the art market. This was, in many cases, a political imperative.

Today we have a fourth generation of digital arts practitioners, in an established domain in the creative arts with a 50 year history. At risk of generalising, this generation of artists is arguably more pragmatic than their forebears. However, it is the case that much digital arts activity remains focused on unstable media and is undertaken at either the margins of the mainstream visual arts world or outwith it altogether.

Why is this? Could it be that the ideals of generations of experimental artists have had limited impact and the traditional values we earlier identified, as underpinning the commodification of art, sustain the determination of the canon? It seems that few collectors are willing to invest in art works that might survive for only a few years - or even minutes or seconds. Few private collectors are keen to get involved in the expense of developing novel preservation techniques for those digital art works that may have the potential to be conserved. The art market and thus, to a considerable degree, mainstream visual arts practice, is driven by private collector's cheque books. You have to "follow the money" to find "where the action is", and it is not in digital art. This was publicly affirmed by Ekow Eshun, when he announced the closure of London's Institute of Contemporary Arts' Live and Media Arts department, citing its "lack of cultural urgency" (Gardner, 2008), by which he meant mainstream (née market determined) interest. Eshun's subsequent departure from the ICA was possibly not unconnected with the political fallout of that decision but was mainly due to the parlous state of the ICA's finances. In this there is a comforting irony for artists engaged in the media arts.

Nevertheless, the ICA aside, there are a number of public museums investing in developing media arts (including digital) conservation programmes. Tate, MoMA, the Stedlijk, SFMoMA, the Pompidou and a few others are leading on this work. A smaller number of specialist institutions, such as ZKM, the Daniel Langlois Foundation (which has recently announced it is donating its entire collection to the Quebecois Film Council as its founder departs engagement with the sector), Nederlands Media Arts Institute and the BFI, are also doing important work in this area, as are a number of academic research programmes. The work of Jon Ippolito, previously curator at the Guggenheim responsible for media arts and now Professor at the University of Maine (Depocas, Ippolito, & Jones, 2003), on the Variable Media Initiative, is notable, as is that of Steve Partridge, with the Video Rewind project at Dundee University and Scott Rettberg at the University of Bergen with the European Electronic Literature Knowledge Base. This is all important work but it largely focuses, quite reasonably, on developing conservational techniques for works that the institutions involved have in their collections. By definition, most of these works are by artists who are part of the canon of contemporary art, if only because these institutions have collected their work. As we have observed, much of the activity in the

digital arts remains at the margins, or outside, of the mainstream art world and very few digital works are in such collections.

Most digital art work produced is never likely to be collected, privately or institutionally. Many of the most important works in the field will escape their clutches, often because, as previously noted, artists choose to employ creative strategies to ensure this will be the case. What will happen to this work? If it is lost then it will never be part of the documented history of the domain and, as we know, history consists of what we document. Does it matter if this work is lost? If it does matter, then will it fall to future archaeologists, those whose job it is to reveal what has been lost to history, to recover what they can of such works? If so, then what will they recover?

Errki Huhtamo's and Jussi Parikka's recently released book, Media Archaeology (Huhtamo & Parikka, 2011), indicates that this is not a problem of the future but of the present and, even, the recent past. Many digital art works have already been lost as the media platforms and other dependencies they rely on are superseded by new operating systems, chip-sets and entirely new kinds of media. Some artists speculated that the internet would function as an eternal proxy preservation medium but many works that have network software or hardware dependencies or employ network protocols have been lost as the technology of the internet has evolved. Many net art projects are no longer accessible, are often poorly documented and references to them might only exist in third party media. Igor Stromajer, for example, has just completed deleting most of his online work from his server, removing it from the Internet (Štromajer, 2011). Works such as Stromajer's would seem to present a class of art that now requires the attention of archaeologists rather than historians.

There are some who are suggesting that we are witnessing the demise of the home computer and the evolution of a new platform that offers an experience that, whilst highly interactive, does not possess the profoundly adaptable and interactive characteristics of a fully programmable computer. These new devices are typified by the smart phones, tablets and iPads that proliferate in consumer culture. Core to the design of these devices is the separation of reading and writing. By this, I do not mean conventional writing, as it is possible to undertake word processing on these devices - although that may involve purchasing add on hardware, such as keyboards, to render the writing experience tolerable. I am using the word "writing" here in the profound sense of being able to "write the machine" and make the medium. This is one understanding of what media art can be - not art that employs media but art that fashions media.

A Technological Interdependency

Alan Turing's original conception of the computer was of a symbolic machine - a machine that exists as a symbolic description operating on those symbols according to the descriptions, thus operating on itself and the symbols and descriptions that compose it. Turing's machine is a writing machine that can write and re-write itself. In this sense it is a machine with inherent agency. All computers, to a greater or lesser extent, are instances of Turing's original vision. Some programming languages have been developed in order to render these symbolic ontology's explicit as they are "written" (for example, Prolog). Most computer operating systems are designed to be highly configurable and re-programmable, either by easy to use drag and drop or clickable preference panes or through the re-writing of the "boot" algorithms that run during the start-up of the computer. These "preferences" are symbolic descriptions of what the computer is - its

capabilities, processes, dependencies and properties. Within the scope of the hardware it is possible to create many different types of computer by manipulating these algorithms. It is also possible to automate this process, so that symbolic systems (for example, computer programs) are able to create their own descriptions of what a computer might be. Many computer viruses are designed to do this.

Generally, the more configurable a machine is, especially at a low-level approaching hardware dependencies, the less easy it is use, requiring, as you would expect, a significant knowledge of computational theory and technology. However, as computers have become pervasive in our society and used for a wider range of activities they have also become easier to use. This is, generally, a good thing, enhancing our productivity, experience of things and even facilitating novel forms of expression and experience.

However, computers become progressively easier to use at the risk of denying the user the capability to reprogram or reconfigure the machine. This is the case with many consumer-oriented devices, such as consoles, smart phones and tablets. These machines remain computers in so far as they can run software, perform calculations and interact with external phenomena, like the user's touch. However, they are not "writing machines" in the sense of Turing's vision. It is true that software can be written to be used on these devices - but such software is not written on the device. Rather, it is written on a computer and installed on the client device. Thus it becomes difficult to describe a smart phone or tablet as a "writing machine", in the sense Turing conceived the computer, and thus equally difficult to consider such devices as computers. Their precise status is somewhat unclear.

Is this a problem? It can be argued it is. As smart mobile devices replace computers, as current sales projections suggest they will, those who exclusively use such devices will be unable to "write" their own machines. On many levels this may not appear a significant issue. Most current computer-users do not seek to build their own computers or learn computer programming. However, this emerging scenario evokes the classic dichotomy between production and consumption, the chasm between user and producer. Karl Marx, and numerous other socio-economic thinkers, have written on what happens when people have no access to or power over the means of production. Ted Nelson (Nelson, 2003), has argued that the computer is an inherently revolutionary device as it offers the user access to the means of production, allowing them to redefine those means by reconfiguring the machine itself. For such apostles of computer liberation the arrival of the smart device popularises the technology they helped develop whilst sounding the beginning of the end for their utopian vision.

What has this to do the preservation of digital art?

A Reading and a Writing

The issue here is literacy and being able to read and write; where it is important to be enabled to create something - a text, a machine, a world. This is what artists do. They are people who, through high levels of literacy, are able to create shared experiences, both imaginary and real, symbolic and material. To my mind interesting art works are those that enable the reader to participate in this process of making and becoming, whether by the exercise of their imagination, through the process of interpretation, or by materially or symbolically changing the work itself in some manner. In the case of digital art this interplay of reading and writing has been enabled at the level of the symbolic codes that

describe the machine, the medium, that materialises the work. In these works the explicit processes of "writing" are as dynamic and motile as their potential "readings".

It could be argued that to appreciate writing one needs to know not only how to read but also be a writer - if only for the quotidian task of composing an email or school essay. Like the book, the computer is a platform that is as good for writing as it is for reading, that invites a two way engagement with its potential, such that the reader/writer is able to intervene in and determine what that might be. What would our culture be like if most of us could only read, and gaining access to the instruments for making texts was the preserve of professional "writers"? If we lose the ability to write we will, as non-writers, lose the ability to read, becoming illiterate. Denied the ability to operate in the symbolic universe our capacity to imagine alternate worlds or selves and, ultimately, to make ourselves, will be compromised. We would be "written" by, and become the property of, others. There is deep meaning in the claim that literacy liberates and transforms. In this context digital literacy is also transformational.

Does it matter if many of us lose the capacity to read and write with computers? Arguably it does, if we accept that we live in a progressively mediatised world, a society where our relationships with knowledge, information, work, play and one another are mediated by digital systems at every level. If we wish to be active participants in this culture, rather than passive consumers, then we do need to retain literacy with the dominant media, computers. In this respect the proliferation of consumer smart devices is a threat to our literacy and capacity for creative engagement. Those who are, for whatever reason, excluded from the "digerati" will be confined to the role of consumers of digital culture.

Sherry Turkle has observed, in her recent book Alone Together (Turkle, 2011), that we no longer ask what we use computers for but what we do not. The computer has become essential not only in our practical lives but also in our social and emotional lives. Computer literacy is no longer just a requirement for getting the right job but for navigating and understanding our social relations. However, the social media that have enabled this would appear to be part of the same ilk of technologies as the consumer devices we have already been discussing. We have to ask, are social media part of a drift away from digital literacy or are we witnessing a new form of literacy emerge, an "emotional" literacy, digitally mediated, where we "write" ourselves into being within information space? If we are to accept Turkle's argument the answer to this latter question is, a not unproblematic, no. However, if we accept this is a new form of literacy then we can ask whether we are witnessing an evolutionary step in the human-machine interface, where our capacity to create has become both a materially and socially symbolic operation? If so, we can conceive of media being social in a profound sense; of media platforms enabling the making of social relations, cultures and people. Arguably, it is, as yet, too early to know which is the likely outcome, if either.

Tim Ingold notes that creativity is often considered as an imposition of order by an agent of some kind (Ingold, 2009) but has argued that we can alternatively view it as "an ongoing generative movement that is at once itinerant, improvisatory and rhythmic", weaving with and through the many agents involved - human, material and technological. This is a participative and inclusive comprehension of creativity and, although Ingold does not cite Mauss, this generous approach could be considered to be related to the notion of creativity as "gift", evoking creativity's key role in social formation. At the heart of Ingold's argument is the principle that creativity is an activity, not a thing, and, quoting Paul Klee, he observes that when embodied in an artifact the living dynamic that is

creativity expires. In this vision the work of art appears as no more than the dead and decaying remains of what was the living creative activity.

This returns us to the original conjecture of this text, that many media (and other contemporary) artists have chosen the path they have in order to maintain their focus on art as something you do, not something you make. Many artists have chosen to produce work that defies conservation and collection, existing only for as long as the work is in "play" amongst all those engaged in its making - the author, the reader and others. For many this has not been an aesthetic strategy but pursued out of a particular apprehension of the role of creativity in the weaving (or "writing") of society. Ingold uses the term "textility", with diligence, suggesting not only the archaic process of weaving but also the process of "writing". It is tempting here to consider one of the earliest examples of automation, and its role in the development of computing, the punch card programmable Jacquard Loom, used extensively, from the 19th century onwards, in the textile industries. In this machine we have "writing" and weaving as functions of one another and a mechanical model for how people are made - as necessary attendants to the machine and subjects of the Industrial Revolution, a metaphor for how we are "written" and "woven" as a social fabric. The question remains - who is being made, by whom and to what purpose? We are reminded why literacy is so important.

The risk inherent in a strategy of artistic redundancy, where art works are made to decay, fail or be lost, as the systems they depend on evolve into other forms, is that of forgetting and subsequent illiteracy. Should we seek to preserve works of digital art not because we wish them, as artifacts, to participate in the socio-economic milieu that is the contemporary art world but because, by allowing these works to die, without trace, we are contributing to a cultural forgetting that may ultimately lead us to risk losing our capacity to "write" and thus to read. "Writing" is something we do, not something we make - but it is also something we read, our capacity to write being directly linked to our ability to read, and vice versa. If we lose the possibility of one, we will lose the capacity for the other. If we were to treat all art in this manner, allowing it to decay as soon as its existence as a vital becoming is complete, then we would have nothing to read. This risks ignoring the generative potential in reading that which "remains". In this sense no art work is ever complete or dead. No matter how they are made, or how inert they might appear, art works remain alive and open to new completions. The question is how this is informed by those who are reading? At the same time we recognise that without forgetting, without decay and death, there is no new life, no new experiences and no new memories.

References

Depocas, A., Ippolito, J., & Jones, C. (2003). Permanence through Change: The Variable Media Approach. Retrieved from http://www.variablemedia.net/pdf/Permanence.pdf

Gardner, L. (2008, 23 October). Ekow Eshun and the Ica's Death Blow to Live Art, The Guardian. Retrieved from http://www.guardian.co.uk/stage/theatreblog/2008/oct/23/ica-live-arts-closure

Huhtamo, E., & Parikka, J. (2011). Media Archaeology : Approaches, Applications, and Implications. Berkeley, Calif.: University of California Press.

Ingold, T. (2009). The Textility of Making. Cambridge Journal of Economics, 34(1), 91-102.

Nelson, T. (2003). From Computer Lib / Dream Machines (Originally Published 1974). In N. Montfort & N. Wardrip-Fruin (Eds.), The New Media Reader (pp. 301-338). Cambridge, Mass.: MIT Press.

Štromajer, I. (2011). What Is Expunction? Retrieved from http://www.intima.org/expunction/

Turkle, S. (2011). Alone Together : Why We Expect More from Technology and Less from Each Other. New York: Basic Books.

Documenting the Context of Software Artworks through Social Theory: Towards a Vocabulary for Context Classification

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Introduction

Whereas digital preservation – as a field of knowledge and as a practice – mandates the long-term appraisal, definition and management of the content and context of digital information, it has been repeatedly signaled that context can be elusive and difficult to pin down in meaning (Giaretta, 2011). In the world of software art, this danger is magnified by the temporal, ephemeral nature of artworks whose intrinsic value derives from the *sociotechnical framework* in which they are created, rendered and experienced. Lovejoy, Paul, and Bulajic (2011) argue that – although context has been "traditionally understood as subordinate and supplemental" – the use of digital media in artistic output blurs the boundaries between content and context, so much so that interpretation and documentation depends on "the thematic lens under which [an artwork] is examined". What are the ramifications of this interconnectedness for preserving digital art? Is our long-term ability to preserve the meaning, value and impact of digital artworks impaired by the elusiveness of context documentation and interpretation?

In an effort to investigate platforms for explicitly documenting contextual dimensions of digital artworks, this paper presents an approach towards defining a vocabulary for context classification that builds on the theory of Social Informatics. Software art is perceived here as a sub-genre of digital art, which in turn pertains to the broader domain of new media art. Hence, the analysis transcends the confines of software art and approaches the definition of a context classification vocabulary from the "new media art" perspective. The result is by no means definitive, but rather a vehicle for deliberation and placement of software art in a historical context.

The Context of Software Art as a Sociotechnical System

What is *context?* One definition would be the discourse, facts, circumstances, environment, background or settings that surround a phenomenon and help to determine, specify or clarify its interpretation. From an empirical analysis perspective, this reflection on context is rather vague to allow us to deploy any classification scheme for contextual characterisation of new media art. If the computability – as in *digital*[1], *computer-based* – and interactivity characteristics of software art are considered as dimensions in the context equation, a parallel can be drawn to sociotechnical theories that define a context for computer-based technologies. Viewing software art as a sociotechnical system –

[1] Given the ambiguity of the term 'digital', it is used here to describe artworks where the computer has been used as "a primary tool, medium and/or creative partner" (Wands, 2006).

where the development of artwork binds people, processes and technology in a joint and collaborative effort – could lead to a (re-)appraisal of our understanding of context. Kling (1987) situates the baseline for understanding the *social* aspect of context in three elements: (1) *social relations between actors* that influence the adoption, development or use of the technologies; (2) supporting *infrastructure*; and (3) *historical evidence* of actions taken to develop, operate and showcase related technologies. The possibility for mapping these elements to a context classification scheme for software art is evidenced in relevant literature from the broader domain of new media art.

The *Inside Installations* project, an effort focusing on conservation of installation art, has identified the contribution of social interaction between actors (artists, preservation experts, curators and end-users) within the broader interdisciplinary framework of new media art preservation, in the 'observation / participation / communication' triptych (Scholte & Hoen, 2007). New media art – in its interactive, time-based sense – requires the creation of platforms of exchange that are manifest through technological devices and aim to stimulate a two-way interplay between an individual (or indeed a group of individuals) and a given artwork (Popper, 1997). This interaction is expressed by Weight (Weight, 2006) as a *trilogical* relationship formed when technology is used to mediate creative communication, its constituents being the human programmer/artist, the executing apparatus, and the human interpreter.

However, Weight's concept marginally touches on the blurring distinction between user roles, which often resembles Allan Kaprow's notion of a 'happening' (Kaprow, 2003) where the artistic motivation lies in "increasing the 'responsibility' of the observer and finally eliminating the audience altogether as each individual present [becomes] part of the event organised by an artist" (Cornwall, 1993). From the preservation standpoint, contextual classification needs to move beyond the artwork developer/end-user level, by allowing for the representation of relations of such roles as new media art curators, conservators, commissioners and collectors (Morris, 2001). However, actors and their relations should be studied within the setting(s) where people and the new media art apparatus meet. These apparatus encapsulate not only any programmed or programmable machine, either networked or stand-alone (Weight, 2006) employed by the artwork, but also the plethora of additional parts (such as frames, stands etc.) used to deliver the intended (or at times unintended) experience of the work. The entirety of these parts constitutes the 'supporting infrastructure' element in Kling's definition of context.

But if new media artefacts are in themselves complex agglomerations of virtual and physical characteristics, which are further dependent on environmental – spatial and temporal – factors, what *state* of infrastructural context should a classification scheme reflect? If we accept the parallelism of redefining new media as tendencies in modern art and computing, technologies are not only the enabling factor to materialise the artistic imagination; they are a medium that extends the original idea of a project and as a result have become artworks in their own right (Manovich, 2003). In this sense, the intrinsic characteristics of computer-based technologies – evident in their application within or outside an art template – form the core for providing contextual characterisation. On the other hand, the variety of artistic approaches and the boundaries between what is *art* and what is *technology* blur too much to make terms like 'dynamic', 'interactive', 'collaborative', 'networked', or 'customisable' define precise characterisation of context. What is missing here is the logic behind the sequence of events orchestrating a new media artefact, which directs what is communicated to the audience, when and why.

As Paul (2007) explains, "[w]hile every art project is embedded in its own specific context, the shift towards a dependency on context increases with new media works that

require information about which data (in the broadest sense) is being shown, where it is coming from, and according to which logic it is configured." Paul pinpoints two additional issues that must be included in the identification of infrastructural context; the first is an account of the different manifestations that new media art works can have and speaks to the medium's variability and modularity. Indeed, the same work can potentially be instantiated as part of an online exhibition, as an installation or a projection within a physical space, or form part of digital archival material. The second issue is the definition of the physical environment as dictated by the specification of artwork requirements in terms of physical and virtual space. In this sense, *context* should describe how the connection – if any – is established between the physical and the virtual. The introduction of manifestations and physical environment in the classification scheme can be based on the experience and assumptions of the preservation/documentation professionals about the ways in which a work could be presented; or draw on historical evidence collected from existing experience with presentation/ instantiation/ documentation of a set of related works.

In Kling's definition of social context for computer-based technologies, this historical evidence describes three distinct entities: development, operation, and showcase of technologies. A number of publications exist that offer a historical roadmap to the emergence and evolution of new media art (Berwick, 2001; Castle, 2000; Montfort & Wardrip-Fruin, 2003; Rush, 2005). Other scholars have focused on historical facts about presentation and curation of new media art in the museum/gallery context (Candy & Edmonds, 2002; Greene, 2004; Morris, 2001; Christiane Paul, 2003; Christianne Paul, 2007; Rugg & Sedgwick, 2007). Candy & Edmonds (2002) and Greene (2004) provide a comprehensive overview of the history of the field, which shows that the use of digital technology for artistic creation is not a new phenomenon and in fact dates back to the 1960s.

What we understand today as new media art is the combination of traditional cultural conventions – which stem from human experience and visual reality, and new conventions of data representation – which are numerical, computational data (Manovich, 2003).

From this perspective, the points of convergence between historical cultural forces and digital data use through Human Computer Interaction (HCI) can inform the definition of contextual elements for new media art works. Consider for instance Mark Napier's *Feed*[2], a net art piece that appropriates raw material on the Web not with a goal to provide information, but instead "[consume] information, reducing structure, meaning and content to a stream of text and pixels"[3]. This type of work challenges, indeed redefines, cultural conventions and implicit assumptions regarding conventional perception of technologies whose every-day use has become ubiquitous in our (developed world) society. The aesthetics of new media art, which assume the existence of historically particular characteristics of artistic and cultural production (Manovich, 2003), point toward a shift of focus from the digital and technical to the visual and stylistic aspects of digital artworks. In order to promote how human-computer interaction can be understood as an aesthetic discipline, Bertelsen & Pold (2004) have introduced the *Interface Criticism Guide*. The guide draws on media and digital aesthetics theory to discern operational perspectives that can be used for the study of visual aesthetics of new media art, so as to address the definition of a vocabulary for *cultural context* that takes into account "the dynamics of interaction in new and relevant ways" (Bertelsen & Pold, 2004).

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[2] http://potatoland.org/feed/

[3] Source: http://potatoland.com/feed/about.html

A Vocabulary for Context Classification

How can the different expressions of context reviewed above be situated within an operational definition of a vocabulary for contextual classification? Kling (1987) suggests the use of *situations* as a methodology to encapsulate different contextual facets in a scheme that is dependent on: (1) the number of participants (individuals or larger collectivities) that engage with a computer-based technology; (2) the set of artefacts involved; (3) the spatial scale and arrangements of activity; (4) the time periods of activity; and (5) the primary social processes that shape critical behaviour. Using a *situation* as the primary unit of analysis is suitable for defining a context classification vocabulary, particularly because it allows for scalability within and among these five dimensions. Mapping again to new media art, specific situations can be located along, for instance, the first two dimensions based on the number of users that can view/interact with a piece simultaneously. Other situations may be located by the amount of space their equipment occupies and/or the amount of space the participants take up when engaging with the artefact. Time periods of activity can describe the amount of time over which key events of the artwork take place, the total duration of possible interaction between user and artwork, or other temporal components – such as scheduled tasks programmed in a software art work. Social processes can describe critical relationships between 'participants' – and by this we refer to all kinds of stimuli for cooperation or conflict between actors involved in the creation/presentation/preservation of a work; social processes also include beliefs, critiques, resources, common practices, procedural elements and constraints associated with new media art works. In addition to this scalability advantage, situations are open-ended in the sense that the abovementioned dimensions and their characteristics are extensible and flexible enough to permit augmentations and tailoring to particular needs. Table 1 [adapted from (Kling, 1987)] summarises these situational dimensions and some of their characteristics that can be used as a starting point for building a vocabulary for context classification for new media art (and, in extension, software art) works.

Population Scale

Starting with population scale, the most basic contextual element involves the transient encounter between an individual and an art work. For instance, Antonio Mutandas' *This Is Not an Advertisement* (1985) was an animated sequence of words created for the Spectacolor Electronic Billboard in Times Square, New York; as it momentarily subverted the public space – its position manifest in the urban context (Alonso, 1998) – the interaction between vehicles and passers-by with the work was equally brief. A larger scale of the population dimension is that of an individual assuming a role within the greater new media art environment; an artist, a museum curator, a preservation officer, a collector, an art historian or an artwork observer are all roles that affect to varying extents the meaning of context. Although not new media art-specific by nature, the type of participation of these roles in a *situation* is influenced by the more new media art-specific characteristics of other dimensions. Moving from the individual to the more collective entities, the population scale ranges from an institutional subunit or an entire institution, to a community.

Dimension	Characteristics
Population Scale	Encounter Role Institutional Subunit Institution Community Social World
Equipment (Infrastructural Context)	Simple ↔ Complex Obsolete ↔ State-of-the-art Disconnected ↔ Closely-coupled Single owner ↔ Multiple owners Open source ↔ Proprietary Manifestations: Monolithic ↔ Modular Invariant ↔ Variable
Spatial Context	Local ↔ Global Compact ↔ Geographically dispersed (distributed) Environment: Physical ↔ Virtual
Temporal Context	Time Scale: Picoseconds ↔ Centuries Scheduled ↔ Random Perishable ↔ Time persistent
Aesthetical Context (Cultural / Historical Context)	Stylistic References Materiality Remediation Genre Hybridity Representations
Social Processes (Behavioural Context)	Critical Relationships: Cooperation ↔ Conflicts Direct ↔ Mediated Beliefs & Critiques: Isolated ↔ Wide-spread Common Practices: Standardised ↔ Ad-hoc Procedures: Community-adopted ↔ Institution-specific Constraints: Political Legal Physical Cultural Financial

Table 1: Situational Dimensions Related to New Media Art

At the highest end of this dimension is the social world, which describes the entire set of entities that constitute the social environment where new media art is created, disseminated, presented and preserved. Population scales influence the remaining contextual elements of a work, particularly in terms of social processes that bind together a behaviour setting that surrounds new media art objects and the relationships of the group(s) that populate this setting. Social processes derive from and shape participants' actions in relation to infrastructural, temporal, spatial and cultural characteristics (Kling, 1987).

Infrastructural Context

The equipment and infrastructure necessary to create, present and interact with new media artwork are key elements in defining situations. Infrastructural characteristics for a given artwork refer to the associated resources that are needed to realise or perform a work and achieve the original artistic intentions. Although these characteristics can potentially be static, they are unlikely to remain unchanged for a long time because new media art is still evolving (Manovich, 2003). To represent this in the vocabulary, pairs of related characteristics are presented in Table 1 as two ends of a continuum on which specific situations can be placed; as a work evolves, its position on each continuum can change respectively. Hence, the supporting infrastructure for an artefact can range from:

- **Simple to Complex**. The positioning of a work on this continuum depends on such requirements as staff, supporting documentation, equipment contracts, programming skills or working hardware/software. For instance, a multi-part installation that requires assembly of physical parts and configuration of computer-based parts calls for skilled staff and equipment to install the piece, accurate and complete construction documentation and the provision of related software and hardware to render the coded components. The complexity of infrastructure can also be an indicator of the population layers that are involved in the management processes related to an artwork. Generally, a work is considered more complicated when the requirements for its support cut across many institutional sub-units or many institutions (Kling, 1987).

- **Obsolete to State-of-the-art**. This continuum represents the potential of digital artworks with obsolete components to be migrated to or emulated on contemporary media, and its converse – i.e. the efficiency and suitability of modern infrastructure for supporting the requirements of obsolete equipment through migration/emulation or other digital preservation techniques. An example of defining this situational characteristic is the *Seeing Double* exhibition (2004) which featured "a series of original art installations paired with their emulated versions"[4].

- **Disconnected to Closely-coupled**. This pair of characteristics refers mainly to the relationship of a new media artwork with networked environments. At this level, the requirements for equipment – and interrelated entities that ensure the proper handling and operation of the equipment, as described earlier – can vary significantly. In their effort to push the boundaries of technologies, artists can

[4] Source: http://variablemedia.net/e/seeingdouble/

employ systems and computer infrastructure of high sophistication. This continuum is wide enough to encompass all types of technical dependence on networks: from disconnected, stand-alone artefacts to 'artworks-as-information-systems' characterized by large numbers of processing elements interconnected by some scalable high performance network (Schlichtiger, 1991).

- **Single to Multiple Owners**. The issue of ownership is addressed here from a supporting infrastructure perspective, rather than from an intellectual property perspective for the artwork itself. Single ownership is perceived as a case where all the associated resources needed to experience a work ensue from a single role, institution or community. An art installation commissioned, managed and curated exclusively by one museum is such a case. On the other hand, multiple ownership of resources refers to cases where the infrastructural prerequisites to realise a work come from different sources. For instance, the supporting infrastructure for net art works stems from multiple owners: one might be the provider of storage space on a server for the Web pages; another is the Internet Service Provider (ISP) company that offers access to the Internet so that people can view the work; a third might be a private company commissioned to maintain the web site of the hosting institution where the net art work resides.

- **Open Source to Proprietary**. The creation of computer-based artwork inevitably requires the use of equipment (software and hardware) that can vary between open source, protected by intellectual property rights, or a combination of both. From this standpoint, the nature of the equipment influences the interpretation of the supporting infrastructure. A digital work administered in the native format of software can only be rendered by use of these applications and therefore requires the obtainment of a license from the parent company; proprietary software is licensed under limitations, which further forbid processes such as reverse-engineering for preservation purposes.

- **Monolithic to Modular**. A work is perceived as monolithic when it is made up and fabricated as a single, one-piece, integral structure. This structure is unchanging and therefore only allows for one manifestation. Le Corbusier's *Poême électronique* (1958) is such an example. The work consisted of black and white video, colour light ambiances, music moving over sound routes, visual special effects and was created specifically to be installed within the Philips Pavilion building; it has never been reprised after the end of the exhibition (Lombardo *et al.*, 2006). On the other hand, a modular work is composed of units or sections that can be reconstructed or permit flexible (re)arrangement. The work of team *Soul Condenser* for the 3rd Workshop of the Design Department at Domus Academy (2007) is a modular installation that uses water and therefore the walls are made of different materials that are re-adapted according to the environment in which the work is exhibited (for instance, ice would be used in cold weather, transparent thermoformed plastic filled with water for indoors exhibition and water fountains for warm climates)[5].

[5] Source: http://www.mararibone.com/index.swf

- **Invariant to Variable**. New media art that uses computerised resources can take inputs and/or produce outputs whose values are liable to change while the work is being experienced by an audience. Within this definition of context, the position of such works tips toward the variable end of the continuum. The distinction between invariant and variable artworks addresses the issue of capturing the logic behind the artistic piece which dynamically processes inputs and generates related outputs. The common denominator of variable works is that a singular experience – i.e. the way that one specific user interacts with the work and the outputs produced by this interaction – cannot be duplicated. For instance, in Ken Feingold's *Sinking Feeling* (2001)[6] and Stelarc's *Prosthetic Head* (2003)[7] the artworks respond to human feedback and engage in a dialogue with the observer that depends on the inputs provided. Leeson's *Synthia Stock Ticker* (2003) and Joshua Portway and Lise Autogena's *Black Shoals Stock Market Planetarium* (2004) produce varying results and representations of data coming from stock market figures reported on the Web. In contrast, invariant works are characterised by either unchanging outputs – as in a video recording – or pre-configured logic; the outputs in this case can be duplicated if the input provided by any user is the same. An example of the latter is Barbara Bloom's *Half Full-Half Empty* (2008)[8] where the viewer can choose between events in the past, present and future but the resulting scene is always the same.

Spatial Context

Equipment and infrastructural context are closely related to the spatial dimension of a situation, because they are manifest through some kind of physical existence. However, in new media art *space* can take the form of a virtual environment as well – and this is particularly true for virtual reality, immersive projects. The characterisation of the spatial setting of new media art works is the result of a process that is based on evidence and objectives that derive from the overall framework surrounding a work's commission, acquisition, exhibition, presentation or preservation strategies. These strategies reflect the decision-making mechanisms for identifying priorities, programmes, policies and space allocations alongside with the resources necessary to deliver them. Such decisions may include:

- The confirmation that the space occupied by a work is available at the right time and in the right place and that it accords with the requirements for social and physical infrastructure.

- The accordance of costs incurred by the use of a space with institutional policies and availability of funds. In cases where a work is installed in a public space[9], the understanding of policies extends beyond monetary terms and requires cooperation from public services and authorities.

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[6] http://www.kenfeingold.com/catalog_html/sinking.html
[7] http://stelarc.org/?catID=20241
[8] http://www.diacenter.org/bloom/
[9] For instance, see Kit Galloway and Sherrie Rabinowitz's Hole-In-Space (1980) installed at the Lincoln Center for the Performing Arts in New York City, and "The Broadway" department store located in the open air Shopping Center in Century City, LA. (Source: http://www.ecafe.com/getty/HIS/)

- The contribution to local distinctiveness and community-specific objectives, which – from an institutional viewpoint – justify the investment in a work and promote economic, environmental and social benefits for a community.

Building on the above, the characteristics of the spatial dimension can be mapped to new media art as follows:

- **Local to Global**. The spatial dimension is characterised as *local* when the incentives to deal with or create an artwork (depending on whether the issue is perceived by an institution's or an artist's side respectively) serve the concerns of a local community. The aim is to generate "critical socio-cultural context, as well as [promote] public critical discourse and new forms of creative collaboration in the local community" (Šukaityte, 2008). Based on the nature of the environment where the work is situated, these communities can belong to both a physical and a virtual sphere. Examples of local spatial context include events like the *Fertile Ground* exhibition[10] and the creations of such artists as Judy Baca[11] and Suzanne Lacy[12]. At the other end of the continuum, the spatial dimension is characterised as *global* when the outreach of an artwork is universal and not confined by any kind of boundaries.

- **Compact to Geographically dispersed.** The operational requirements of a work influence not only the amount of space that the artefact occupies, but also the amount of space and spatial arrangement necessary for observers to experience it. Hence, a *compact* artwork is understood as one that is arranged within a single space that can be relatively small compared to the entire environment within which it is situated. In contrast, a *geographically dispersed* work is comparable to a distributed system architecture, with the artistic experience being provided by components scattered in different locations that collaboratively run tasks in a transparent and coherent manner. Examples include *Hole-in-Space*[13] and Jeffrey Shaw's *The Distributed Legible City* (1998)[14].

Temporal Context

Similarly, we can discern temporal characteristics of new media art that describe a situational dimension related to time periods of activity. These include:

- **Timescale: Picoseconds to Centuries**. Although *time* has been a recurring theme and notion throughout the history of Fine Arts in general, the arrival of computerised means to create art has revolutionised the way that artists can exploit temporal qualities to produce highly time-based artworks. The limits of the Timescale continuum represent two extremes, which are nonetheless potentially achievable and evident in new media art works. Sadie Benning's *Play Pause* (2006)[15] video installation displays a narrative through gouache illustrations, with each image

[10] http://rhizome.org/editorial/fp/reblog.php/1756
[11] http://www.judybaca.com/now/index.php
[12] http://en.wikipedia.org/wiki/Suzanne_Lacy
[13] See note 9
[14] http://www.jeffrey-shaw.net/html_main/show_work.php?record_id=102
[15] http://c-d.tumblr.com/post/979805993/sadie-benning-play-pause-2006

appearing only for a couple of seconds[16]. At the other end of the continuum, John F. Simon Jr.'s *Every Icon* (1996) needs approximately six billion years to reach the end of the second row of a 32x32 square grid (Wands, 2006).

- **Scheduled to Random.** This continuum refers to the time sequence of events unfolding as part of a new media art work. While in *scheduled* works this sequence is pre-defined and hence the experience received from the piece by different users is theoretically the same, artefacts characterised by randomness in the temporal dimension expose their events in no specific fashion or in a non-linear manner. The latter differ from *variable* artworks, because they do not necessitate some kind of user input to produce a result (in which case the event is not random, it is 'user-driven'). An example of a scheduled work is Janet Cardiff & George Bures Miller's *The Telephone Call* (2001)[17], a video walk that leads visitors through the museum on a meandering tour up the central staircase, taking them briefly into a nearby gallery, and then into a service stair normally off limits to visitors; the path that the walk follows is pre-defined[18]. On the other hand, in Nam June Paik's *Participation TV II* (1969), signals sent from video cameras to television sets were manipulated randomly by acoustic signals, and the result was that viewers could see images of themselves distorted in random ways, interacting with the abstract forms and patterns on the screen (Decker-Phillips, 1998).

- **Perishable to Time-persistent**. The advent of new media art – and contemporary art in general – has marked a new era in the materials that artists use to bring their creativity to life. This pair of characteristics addresses the emergence of works that may be (intentionally or otherwise) short-lived due to their construction from *perishable* materials, as opposed to works whose deterioration, ageing and wear is at a par with traditional art forms and thus considered more *persistent* to the passing of time. Within a context classification scheme, this issue is of particular importance as institutions and collectors have been struggling to preserve and insure perishable new media art pieces (Benedictus, 2004; McQueen, 2007). Examples are numerous: from Sarah Lucas's *Two Fried Eggs And Kebab* (1992) and *Au Naturel* (1994)[19] to Damien Hirst's *Love Lost* (1999)[20] and Dan Peterman's *Store (Cheese)* (1991-93) (Coulter-Smith, 2006).

Aesthetical Context

Aesthetics can provide a solid representation of the cultural and historical context that spans a work's lifetime. The original situational dimensions for computer-based technologies defined by Kling (1987) do not include a cultural dimension as such – although glimpses and traces of it can be witnessed among the characteristics of the remaining dimensions. The theory and guide developed by Bertelsen & Pold (2004) to provides the basis for an initial vocabulary for aesthetical context, which is based on six operational concepts:

[16] Source: http://rhizome.org/editorial/2642
[17] http://www.sfmoma.org/multimedia/audio/aop_tour_421
[18] Source: http://www.cardiffmiller.com/artworks/walks/telephonecall.html
[19] Source: http://www.bbc.co.uk/dna/collective/A6641318
[20] http://www.artnet.com/artwork/58443/414/damien-hirst-love-lost.html

- **Stylistic references**, whose source can be found in three areas. One is inheritance from predecessors and normative guidelines in the HCI field. For instance, Char Davies' work *Ephémère* (1998) is an interactive fully-immersive visual/aural virtual artwork which furthers the work begun in an earlier project called *Osmose* (1995)[21]. Jeffrey Shaw's *The Distributed Legible City* (1998) is a new version of his 1989 project, which extends the original's aesthetics with multi-user functionality. Similarly, human interface guidelines proposed by Apple[22], Microsoft[23] or Nokia[24] influence the aesthetics of software and create a coherent look-and-feel among – otherwise dissimilar – applications[25]. Stylistic references can also be found in art and architectural history; The aforementioned Bertelsen & Pold suggest a number of ways that interface style can be characterised as baroque, renaissance or romanticist. Lastly, stylistic references can be expressed through 'fashions' in application design. In the new media art paradigm, such cases include Avatars created for virtual worlds (Liao, 2008) and artistic customisations for application software – such as skins and wallpapers for mobile phones, and themes for operating systems' graphical user interfaces.

- **Materiality** seeks to identify the materiality and remediation of the interface through which the audience experiences and communicates with a digital artwork. Materiality is used here to describe the constituents of a digital work's interface, such as code, algorithms and pixels. In new media art, there are examples of deconstructive interfaces which expose their own construction or that of other resources. Perhaps the best specimen of this type of work is the art of Joan Heemskerk and Dirk Paesmans – a collaboration established under the title *jodi*[26]. Jodi's net art is famous for "[stripping] away the reassuring navigation bars and identifiable pictograms of the everyday Web site to let loose the HTML behind the façade" (Ippolito, 1999).

- **Remediation**, a new media theory by Bolter & Grusin (2000), proposes the logic of remixing older media forms with newer ones and vice versa; the theory sheds light on the interdependency of all media and highlights the ways that reality itself is mediated by and for social actors[27]. New media art is often the product of mixing together text, video, audio, machinery and digital technology. Game art offers a good example of remediation and its many facets, with such works as Mike Beradino's *Atari Painting* (2008)[28] and Michael Bell-Smith's *While We Slept*

[21] http://www.immersence.com/ephemere/index.php
[22] http://developer.apple.com/documentation/UserExperience/Conceptual/AppleHIGuidelines/XHIGIntro/XHIGIntro.html
[23] http://msdn.microsoft.com/en-us/library/aa511258.aspx
[24] http://www.forum.nokia.com/Tools_Docs_and_Code/Documentation/Usability/UI_Style_and_Visual_Guidelines.xhtml
[25] For instance, see Liliana Porter's *Rehearsal*, Barabara Bloom's *Half Full – Half Empty* and Dorothy Cross's *Foxglove* (all in Dia's Web Projects page: http://www.diabeacon.org/webproj/). The three artworks share similar features in their interface that are inherited from the common use of Adobe Flash. These features are distinct from, say, Napier's *Net Flag* (http://netflag.guggenheim.org/netflag/) interface – developed in Java and presented online as a Java applet.
[26] http://www.jodi.org
[27] Source: http://en.wikipedia.org/wiki/Mediation_(Marxist_theory_and_media_studies)#Remediation
[28] http://mikeberadino.com

(2004)[29], which appropriate vintage video games to create a remediation of the original with a new scope. The converses of these works are the creations of artist and sign maker Melissa Jones who creates original wood carvings of classic arcade characters[30].

- **Genres**. The issue has been explored in a number of publications (Lichty, 2000; Strehovec, 2009; Tribe & Jana, 2006; Wands, 2006). Although there is no standard genre vocabulary, the linchpin of the scholarly approaches is the understanding that a classification of genre builds on traditional art practice and can only be temporary – based at each time period on the contemporary state-of-the-art technology and evolving / being redefined as new technologies emerge and "become more refined and familiar" (Wands, 2006). At the same time, genres can further "define roles for the user and his interaction" (Bertelsen & Pold, 2004) with new media artefacts that varies between, say, an interactive installation and a digital imaging piece.

- **Hybridity** exposes the agglomeration of functional and cultural interfaces that surround new media art. Consider for instance *Crank the Web* (2001)[31] by Jonah Brucker-Cohen, a browser that allows people to physically crank their bandwidth in order to see a website. The idea behind *Crank the Web* is to combine ancient forms of automation with today's digital telecommunications technology, thus creating a hybrid between mechanics and digital technology.

- **Representations**. The above-mentioned concepts of stylistic references, materiality and remediation, genre and hybridity reflect features of aesthetic theory and how these contribute to an understanding of a cultural context shaped by historical evidence. Bertelsen & Pold (2004) hold that these features contribute towards an awareness of issues and related analysis methods pertaining to *representations* of new media. Based on this logic, they distinguish two types of representations: realistic or naturalistic versus symbolic and allegorical. This idea is not new; representation in the Arts has been the subject of many philosophical debates from Plato and Aristotle to Duchamp, McLuhan, Adorno and Dutton. For instance, Dutton (Dutton, 2008) has expressed seven signatures in human aesthetics that include virtuosity, non-utilitarian pleasure, recognisable styles, criticism, imitation, special focus set aside from ordinary life and imagination. However, many new media art works are essentially exceptions to these signatures. For instance, in jodi's net art, virtuosity of web technology is deliberately avoided; or Cohen's *Crank The Web* contradicts non-utilitarian pleasure. These characteristics of the cultural dimension in identifying a *situation* – and therefore classify contextual elements - might not be immediately observable and possibly difficult to represent and use as part of a vocabulary, but influence the nature of the other dimensions.

[29] http://www.foxyproduction.com/artist/workview/5/167
[30] Source: http://technabob.com/blog/2008/03/15/awesome-arcade-game-art-by-melissa-jones/
[31] http://www.mee.tcd.ie/~bruckerj/projects/cranktheweb.html

Social Processes

How do the abovementioned dimensions and their related characteristics fit into a grander scheme of things, which initiates, motivates or discourages and dissuades certain behaviours in the participant ecology? Social processes are perceived here as a means to work towards addressing the issue of *behavioural context*. Kling (1987) offers that the way participants in a situation conceptualise their actions, adopt practices and procedures, form coalitions and deal with constraints is influenced and dictated by another situation that is larger on at least one of the other dimensions. The boundaries of this *defining situation* used to interpret the *focal situation* are defined by criteria that regulate how limited or encompassing the boundaries will be. Building on these views, the characteristics of social processes are summarised in Table 1. Mapping social elements to new media art is by definition prone to exclude certain elements or lack depth, simply because these processes are complex and often very specific to particular contexts. Notwithstanding the potential for a shortcoming, we will attempt to at least explain how these elements could be interpreted within this context classification vocabulary:

- **Critical relationships** between participants are essential for understanding the environment surrounding the creation, commission etc. of new media art. To this end, two continuums are suggested. The first ranges from *cooperation* between participants/populations scales to *conflicts*; it represents agreements, debates, joint actions, oppositions or controversy surrounding either individual pieces or new media art in general. An example that has become ubiquitous in modern discourse is the ongoing debate in the institutional art world on whether new media art constitutes a distinct field, whether it should be considered 'just art' or even whether it is art after all (Dietz, 2005). On the other hand, Community Art is a case where the social environment promotes or at least strives for cooperation between participants. At an institutional level, cooperation and conflicts represent the relationships between roles / subunits within the institution or among institutions. The second continuum describes the nature of these relationships, based on the distinction between *direct* and *mediated* contact. For instance, a common occurrence in modern museum practices is for a curator to closely collaborate with a new media artist, often exchanging ideas and helping each other to understand their role in the lifespan of the work. In other cases, communication between artist and audience is mediated by some third party. Such cases include online art galleries that provide artists with a platform to promote their work to potential buyers/collectors without the necessity of interpersonal contact.

- **Beliefs and critiques** describe the discussion or evaluation of new media art and can range from *isolated* – as in the body within the arts community engaging to art criticism – or *widespread*, which can extend as far as encompassing the social world. The breadth of this characteristic depends on the level of population scale under which a particular instance of the classification scheme is viewed. Similarly, procedural elements can be studied anywhere between institutional and community levels. These procedures may describe the manner that a work is acquired and installed within an institution's physical space, management decisions over funding for an art commission, assessment procedures in order to evaluate the impact of a work on the target audience, surveillance procedures to ensure the security of an exhibit, or conservational methods.

- Akin to procedures are the characteristics of a situation that refer to **Common Practices** in dealing with new media art and can range from standardised to ad-hoc. From an institutional standpoint, these may include the process and policies adopted for documentation and preservation. From an artistic point-of-view, these practices describe situations where the methodology of the artist has a direct effect on some aspect of social life (e.g. hacking-as-art of everyday tools, communication platforms etc.[32])

- **Constraints** position the role and consequences of limitations and restrictions placed on all the aforementioned dimensions, and can stem from a variety of sources. Constraints are possibly one of the most difficult facets of context to include in a vocabulary, particularly when the suggested terminology needs to be rigorous and thorough. In this sense, it would be unrealistic to provide an inclusive account of examples; constraints are very 'situation-specific' and can vary between cases, so much so that what constitutes a limitation in a particular context might be negligible in another. A reasonable – and definitely more thorough – account of potential constraints with new media art is given in Middlebrooks (2001).

Conclusion

The contextual dimensions presented in this Chapter and their characteristics are not orthogonal. Many are mutually dependent and require combined consideration in order to fully describe the contextual background of a work. This study provides a first step towards reaching the objective of a vocabulary for context classification by use of sociotechnical theories. The approach needs to be empirically validated so as to gauge its suitability and understand its potential impact on situating the much sought after but thus far eluding 'pinning down' of software art context.

Acknowledgements. This work was supported by the Planets Project (IST-2006-033789), funded by the European Commission's IS&T 6th Framework Programme. The work was conducted at the Humanities Advanced Technology & Information Institute (HATII), University of Glasgow, with valuable contributions by Prof. Seamus Ross and Andrew McHugh.

References

Alonso, R. (1998). This Is Not an Advertisement. An Essay on Muntadas' Work in Video and Internet. Retrieved from http://www.roalonso.net/en/videoarte/muntadas.php

Benedictus, L. (2004). Here Today, Gone Tomorrow?, The Guardian Online. Retrieved from http://www.guardian.co.uk/artanddesign/2004/oct/09/friezeartfair2005.friezeartfair2

Bertelsen, O. W., & Pold, S. (2004). Criticism as an Approach to Interface Aesthetics. Paper presented at the Third Nordic Conference on Human-computer Interaction, Tampere, Finland.

Berwick, C. (2001). The New New-Media Blitz. ARTnews. Retrieved from ARTnews website: http://www.artnews.com/2001/04/01/the-new-new-media-blitz/

Bolter, J. D., & Grusin, R. A. (2000). Remediation : Understanding New Media. Cambridge, MA: MIT Press.

Candy, L., & Edmonds, E. A. (2002). Explorations in Art and Technology. New York: Springer.

Castle, N. (2000). Internet Art and Radicalism in the Digital Culture Industry. Retrieved from Lulu website: http://video.lulu.com/items/volume_1/89000/89324/2/preview/netart_preview.pdf

[32] Source: http://www.neural.it/art/2008/02/plink_jet_plucking_inkjet_prin.phtml

Cornwall, R. (1993). From the Analytical Engine to Lady Ada's Art. In T. Druckrey & C. Stainback (Eds.), Iterations: The New Image. Cambridge, MA; London: MIT Press.
Coulter-Smith, G. (2006). Deconstructing Installation Art. Retrieved from http://www.installationart.net/
Decker-Phillips, E. (1998). Paik Video. Barrytown, N.Y.: Barrytown, Ltd.
Dietz, S. (2005). Collecting New Media Art: Just Like Anything Else, Only Different. In B. Altshuler (Ed.), Collecting the New : Museums and Contemporary Art (pp. 85-101). Princeton, N.J.: Princeton University Press.
Dutton, D. (2008). Aesthetic Universals. In B. N. Gaut & D. Lopes (Eds.), The Routledge Companion to Aesthetics (2nd ed., pp. 297-291). London; New York: Routledge.
Giaretta, D. (2011). Advanced Digital Preservation. Heidelberg; New York: Springer.
Greene, R. (2004). Internet Art. London; New York: Thames & Hudson.
Ippolito, J. (1999). Deconstruction or Distraction? Artbyte (New York), 2(1), 22-23.
Kaprow, A. (2003). "Happenings" in the New York Scene. In R. J. Boland & R. A. Hirschheim (Eds.), Critical Issues in Information Systems Research (pp. 307-362). New York: Wiley & Sons.
Kling, R. (1987). Defining the Boundaries of Computing across Complex Organisations. In R. J. Boland & R. A. Hirschheim (Eds.), Critical Issues in Information Systems Research (pp. 307-362). New York: Wiley & Sons.
Liao, C. L. (2008). Avatars, Second Life® and New Media Art: The Challenge for Contemporary Art Education. Art Education, 61(2), 87-91.
Lichty, P. (2000). The Cybernetics of Performance and New Media Art. Leonardo, 33(5), 351-354.
Lombardo, V., Valle, A., Nunnari, F., Giordana, F., & Arghinenti, A. (2006). Archeology of Multimedia. Paper presented at the 14th Annual ACM International Conference on Multimedia, Santa Barbara, CA, USA.
Lovejoy, M., Paul, C., & Bulajic, V. V. (2011). Context Providers : Conditions of Meaning in Media Arts. Bristol, UK; Chicago: Intellect.
Manovich, L. (2003). New Media: From Borges to HTML. In N. Wardrip-Fruin & N. Montfort (Eds.), The New Media Reader (pp. 13-25). Cambridge, MA; London: MIT Press.
McQueen, M. P. (2007). Perishable Art: Investing in Works That May Not Last, Wall Street Journal Online. Retrieved from http://online.wsj.com/article/SB117927768289404269-email.html
Middlebrooks, K. (2001). New Media Art: A New Frontier or Continued Tradition? Project Zero: Good Work Project Report, 9.
Montfort, N., & Wardrip-Fruin, N. (2003). The New Media Reader. Cambridge, MA: MIT Press.
Morris, S. (2001). Museums and New Media Art. Retrieved from Rockefeller Foundation website: http://www.rockfound.org/Documents/528/Museums_and_New_Media_Art.pdf
Paul, C. (2003). Digital Art. New York: Thames & Hudson.
Paul, C. (2007). Challenges for a Ubiquitous Museum: Presenting and Preserving New Media. NeMe. Retrieved from NeMe website: http://www.neme.org/571/preserving-new-media
Popper, F. (1997). Art of the Electronic Age. London: Thames and Hudson.
Rugg, J., & Sedgwick, M. (2007). Issues in Curating Contemporary Art and Performance. Bristol, UK; Chicago: Intellect.
Rush, M. (2005). New Media in Art. London: Thames & Hudson.
Schlichtiger, P. (1991). Closely Coupled Systems. In A. Karshmer & J. Nehmer (Eds.), Operating Systems of the 90s and Beyond (Vol. 563, pp. 44-47). Berlin, Heidelberg: Springer.
Scholte, T., & Hoen, P. (2007). Inside Installations: Preservation and Presentation of Installation Art. Amsterdam: ICN ; SBMK.
Strehovec, J. (2009). New Media Art as Research: Art-Making Beyond the Autonomy of Art and Aesthetics. Technoetic Arts: a Journal of Speculative Research, 6(3), 233-250.
Šukaityte, R. (2008). New Media Art in Lithuania. Athena: Philosophical Studies, 3(21), 173-186.
Tribe, M., & Jana, R. (2006). New Media Art. Köln; London: Taschen.
Wands, B. (2006). Art of the Digital Age. New York: Thames & Hudson.
Weight, J. (2006). I, Apparatus, You. Convergence, 12(4), 413-446.

Between Code and Space: The Challenges of Preserving Complex Digital Creativity in Contemporary Arts Practice

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Introduction

Society's technological advancements have always inspired wider creativity and provided new frameworks for artistic expression. As artists often seek to assimilate the cutting-edge technologies of their time, the history of art has needed to progress alongside a history of preservation in which improved strategies and mechanisms for conservation have been devised in order to safeguard emerging forms of art deemed culturally significant. At present, the pervasive growth of digital media and its rapid uptake by artists has created different, currently problematic sets of challenges for those aiming to preserve the myriad of technology-based artworks being realised by contemporary practitioners.

Now that the experimental use of digital technologies in art has fully expanded outside its previous confines of self-contained software and hardware systems, digital creativity has become firmly enmeshed within wider, complex and often non-digital contexts. Progressive work in this area commonly relies upon hybrid means of creation like tapping into external sources of live data; exploiting user-generated media repositories; blending digital constructs with traditional analogue materials; distributing processes and outputs across varying combinations of virtual, physical and networked space; incorporating seemingly endless permutations for interaction and dialogue with spectators and participants; and engaging in interdisciplinary collaborations that are firmly rooted in non-arts subjects. The adoption of such possibilities, while opening new terrains for artistic exploration, has also necessitated a fundamental rethinking of historically straightforward issues regarding preservation, in particular, (re)defining what constitutes the actual artwork that is to be documented and preserved.

Shifting from the Digital to the Hybrid

Given the current situation and its undeniable impact on artists using the latest technologies within their practice, it is important to acknowledge and address the apparent shortcomings that arise when traditional methods (or mindsets) of long-term preservation for material art objects are applied to creations that are either wholly or partially digital in nature. In terms of safeguarding the specific software and hardware components that comprise such work, it is certainly useful (if not essential) to gain insights from the technology sector and adopt industry-standard methodologies that have been devised to securely archive digital infrastructures. However, it is equally crucial to understand that technologically-based artworks are often not merely amalgamations of *0s* and *1s* or unique collections of integrated circuit boards, and as such, cannot be defined (much less preserved) by only retaining these discrete digital elements.

Unlike many of my peers, I do not consider myself a *digital* or *new media* artist, but rather, a *contemporary* practitioner who happens to integrate various digital structures within the art-making process. Conversely, such is the importance and extent of my use of digital media, none of my projects produced within the past decade would exist if their computational aspects were removed. Employing technologies usually associated with high performance computing and visualisation, I appropriate (and also derive immense creative inspiration from) numerous types of display systems ranging from broadcast media façades and immersive CAVEs[1] to spherical projection setups and full-dome (360°) environments[2]. However, I often blend these bespoke combinations of software and hardware with a wide selection of analogue ingredients. Traditional fine art materials are intermixed with lines of code and grids of pixels in ways that are as conceptually refined and aesthetically prominent as their digital counterparts.

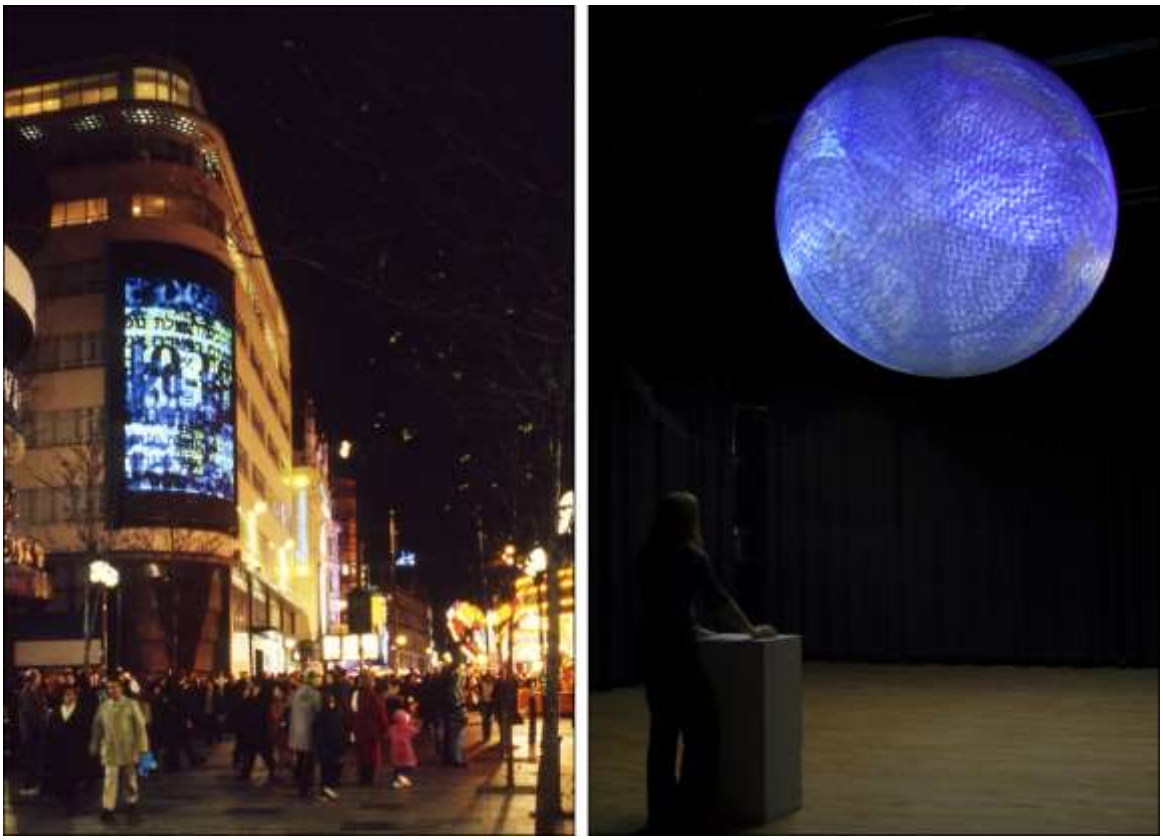

Figure 1. Using visualisation technologies for artistic production: (left) */abstraction/ ii*, digital broadcast video loop (1:28:00) displayed on a LED media façade, commissioned by GMI, Leicester Square, London, UK, 2001. (right) *Data_Sphere*, real-time 3D virtual world (VRML/Java) displayed on a spherical projection setup (inflatable globe design by body>data>space), commissioned by Arts Council England, Brindley Arts Centre, UK, 2008.

Similar to most visual artists working within the contemporary scene, the greater majority of my projects are in some way related to and displayed within traditional gallery spaces such as the white cube and the black box. It is within these surroundings that I strive to liberate the born-digital aspects of my creations from the rigid confines of 'the screen', translating them into tangible forms that are more visceral and engaging for spectators and participants alike. But as with the hybrid forms themselves, such physical manifestations comprise only one channel within a wide gamut of distribution

[1] A CAVE (short for 'cave automatic virtual environment') is an immersive virtual reality setup consisting of three or more room-sized walls onto which the virtual environment is back-projected.

[2] Including large-scale digital planetariums and smaller portable dome systems.

possibilities. Embracing the infinitely reconfigurable quality of new media, I simultaneously release projects across networked and virtual spaces like the World Wide Web and the online metaverse[3] of *Second Life*. Individual artworks mutate through various iterations and formats in a manner that is not too dissimilar from the current production/distribution model of the digital entertainment industry.

Figure 2. Blending technology with traditional art materials and environments: Addressable Memory, solo touring exhibition, curated by Lisa Helin and funded by the Esmée Fairbairn Foundation, installation at Brindley Arts Centre, UK, 2008.

There is no question that such variability greatly complicates the preservation of art created within these contexts. In an ideal scenario, each of my individual projects would benefit from a conservation strategy that is as customised as the work itself. However, adopting this type of highly granular approach is often not practical or even possible since it requires committing substantial resources that are usually beyond the scope of what institutions (or artists themselves) can realistically provide. Given this difficult position, it is crucial to highlight common issues that arise when attempting to preserve these kinds of artworks. For this reason, I will now outline a series of case studies taken from my own practice in order to consider some of the many questions that must be addressed by researchers seeking to develop new frameworks which will help facilitate the preservation of contemporary 'digital' art.

[3] The term, coined by Neil Stephenson in his novel *Snow Crash* (1992), refers to an immersive 3D virtual realm that is metaphorically based upon the real world.

Case Study I: incorporating live external data streams

For the past two decades, artists working with new media have employed computational systems to examine and critique the rise of ubiquitous information structures within society. Unsurprisingly, advanced work in this area has rapidly progressed from using static internalised datasets to appropriating external streams of real-time data. These projects frequently use data sources that are related to our increasingly complex digital lives in order to construct aesthetic forms and environments that echo ever-changing forces within the real world.

One such example is *Data_Plex (economy)*[4] (2009), a networked, real-time art installation that is generated from and evolves with the financial markets. The work reflects upon the unpredictability of the global economy and the capitalist institutions of which it is comprised. It is created from a single live feed of the Dow Jones Industrial Average (DJIA), the most cited international stock index that is compiled from the share prices of thirty of the largest and most widely-owned public companies based in the United States.

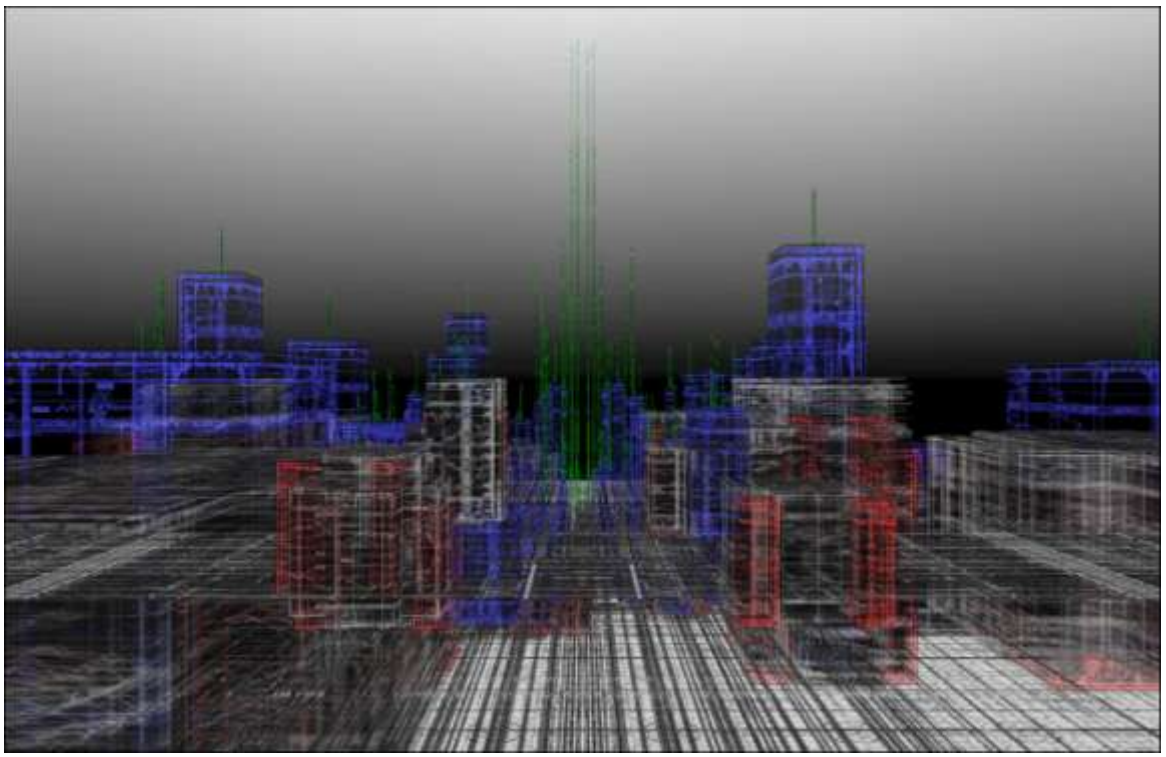

Figure 3. Screen capture of *Data_Plex (economy)*, created with the assistance of Drew Baker (3D visualisation) and David Steele (backend programming), 2009.

From a technological standpoint, the artwork is constructed from a hybrid software pairing consisting of a server-side Java application and a client-side Virtual Reality Modeling Language (VRML)[5] framework that translates the stream of fluctuating stock information into a metaphorical cityscape based on modernist aesthetics of skyscrapers and urban grids. Each corporation is represented in the virtual environment by a series of cubic forms that are proportioned according to factors such as its stock price, market capitalisation and percentage of the DJIA. Current positions drift alongside ghosted (grey)

[4] http://www.takeo.org/nspace/ns031/
[5] A ISO standard file format (VRML97: ISO/IEC 14772-1:1997) for representing 3D vector graphics.

structures of the recent past – dissolving traces from the previous four days of trading. Manifestations of historical (blue) highs, (red) lows and (green) volumes express the fortunes of the market in colour, while each company's representation is textured by a unique image that has been generated by its own financial data. The virtual world ebbs and flows at an erratic pace as vast volumes of capital are shifted during the trading day, while after hours, the realm sleeps in anticipation of the opening bell.

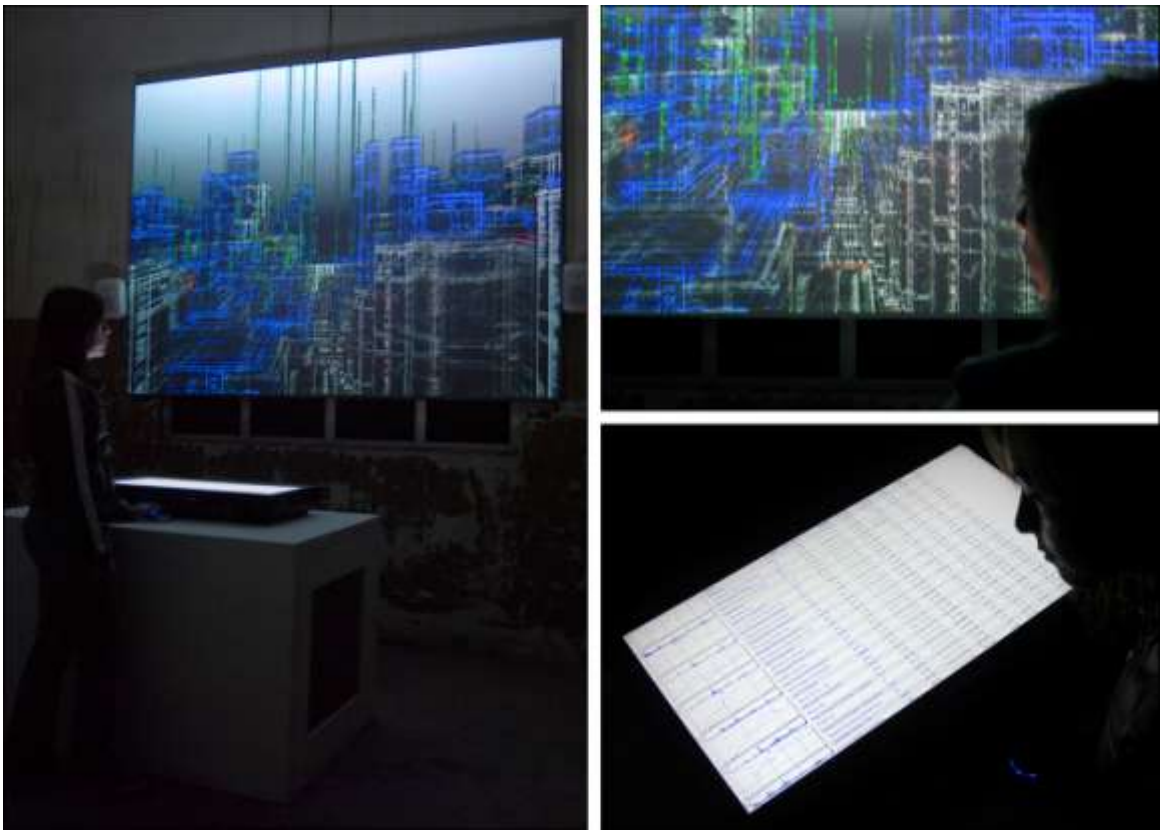

Figure 4. Installation views of *Data_Plex (economy)*, *After the end/False records* exhibition, curated by Nathalie Hénon and Jean-François Rettig, 18th Rencontres Internationales, La Tabacalera, Madrid, ES, 2009.

The artwork's highly structured technical framework makes it incredibly simple to capture a static moment within the virtual space and save the resulting collection of (.wrl[6]) geometry and (.gif) image files that constitute the complete environment. However, can even such a perfect three-dimensional (3D) 'snapshot' adequately convey the fundamental qualities of the piece? *Data_Plex (economy)* was conceived during the immediate aftermath of the 2008 global financial crash, and was intentionally realised in a way that would allow individuals the opportunity to interact with a live embodiment of the financial market and witness its volatile fluctuations in real-time. For this reason, should we not also attempt to record and preserve the data timeline of the DJIA since it both represents and can be used to fully reconstruct the work's evolutionary path? If so, capturing a finite period of this data is readily achievable, even if we must delve into the past and data-mine the DJIA archives. We can reclaim and store a day, a week, a month or perhaps even a year of such information, but considering that the artwork's history continues to unfold as long as the DJIA exists, how can we preserve something that is still being created and whose life expectancy is yet to be determined?

[6] The filename extension for plain text VRML files.

Case Study II: linking to unstable media repositories

If preserving art with elements of live data is incredibly problematic, then what additional issues arise when the integrated data source is continuously affected by the actions of its users? Software-based artists have developed many sophisticated methods for producing generative digital forms, but the complexity of these systems often pales in comparison to those drawing upon the decision-making intricacies of the human mind. For these reasons, I find it far more artistically compelling to tap into data that possesses humanistic qualities and connections. For example, instead of creating a virtual blossom from pre-defined sets of algorithms and texture libraries, it is more conceptually provocative to construct such an entity from actual representations of flowers that have been uploaded into the public domain by living people.

Data Flower (Prototype I)[7] (2010) explores this possibility of creating unpredictable and ephemeral synthetic flora within the deterministic constraints of the digital realm. As with *Data_Plex (economy)*, the 3D structure of the work is produced by a set of VRML files that define the core geometry of the artificial forms within the environment. Similar to previous generations of software art using codified artificial life mechanics, a series of algorithms instigates and directs an endless cycle of emergence, growth and decay upon the virtual blossoms. Randomisation of certain parameters at the onset of each new cycle causes subtle mutations within the petal formations and ensures that every flower develops in a slightly different manner.

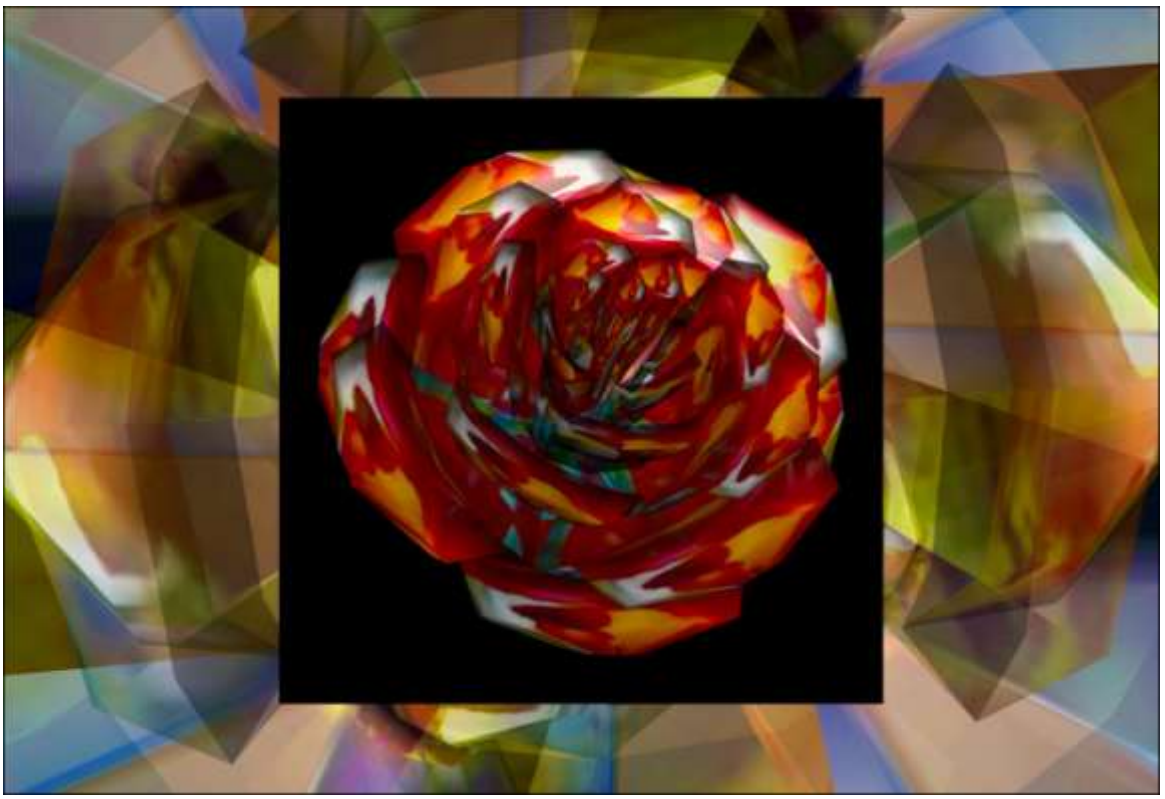

Figure 5. Screen captures of *Data Flower (Prototype I)*, created with the assistance of Drew Baker (3D visualisation) and Erik Fleming (backend programming), 2010.

[7] http://www.takeo.org/nspace/ns034/

However, unlike conventional artificial life systems that are solely based upon unchanging internalised code, the artwork integrates an external, non-deterministic element directly into its creation process. The surface textures of the synthetic blossoms are programmatically constructed each day by a server-side Java application that parses the image repository *Flickr* and selects one hundred of the most recent photographs which have been uploaded with the tag 'flower'. The sampled pictures are then algorithmically prepared and stored as a temporary dataset that is linked to the artwork's VRML structure. On each loop of the flowering cycle, a randomly selected image from the dataset is applied across the growing virtual geometry, thus completing the flower's ephemeral form. As in real life, every virtual blossom the artwork generates is unique since its internal 'genetic' codes induce a perpetual state of flux and its external 'developmental' influence is derived from an ever-changing pool of user-generated media.

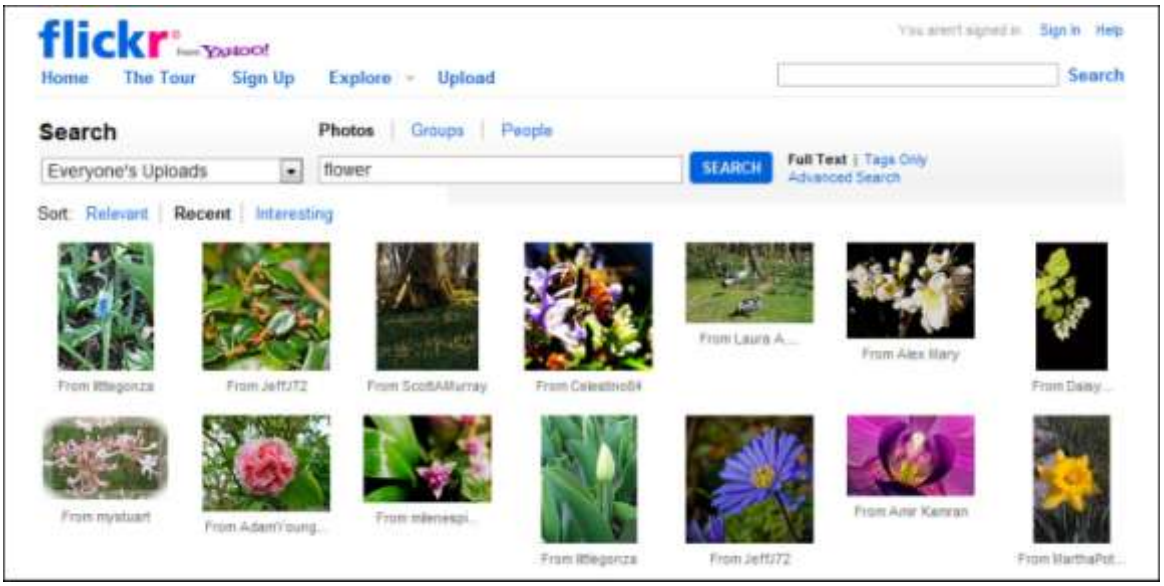

Figure 6. Real-time source material for *Data Flower (Prototype I)* parsed from *Flickr's* ever-changing image database.

With regard to preserving the software framework of *Data Flower (Prototype I)*, the VRML component is extremely simple to conserve since it only consists of a pair of unchanging (.wrl) text files. Furthermore, the Java application and source code can be archived using industry standard protocols, and the programmatically generated images can easily be preserved since they are ISO compliant JPEGs. As a consequence, it is very straightforward to capture a viable instance of the artwork comprising the two VRML files and the current set of one hundred unique JPEGs. This approach would constitute an important first step in preservation, but in such a state the work would lose its unpredictable and highly ephemeral qualities and exist as a stripped-down approximation of its true self. To archive a more artistically accurate version of the piece would require the inclusion of data that could translate these important characteristics. An obvious solution would be to capture and use the work's past trajectory to simulate these features. However, reconstructing even a small fragment of its data timeline is practically impossible. There is no means to obtain the necessary information from the artwork's own internal software framework because the source image data is not permanently stored within a database and the resulting JPEGs are overwritten on a twenty-four hour cycle. Attempting to extract the required historical data from *Flickr* would prove equally futile since its media assets are constantly being altered and removed by its users. To further

complicate matters, even if data-mining *Flickr* in this way was technically possible, would it be legal (or ethical) to attempt to create a data archive from a commercial organisation's digital infrastructure that contains assets which are owned (in terms of copyright) by millions of different independent users?

Case Study III: introducing analogue materials and processes

The secure preservation of many kinds of archived data clearly is an important part of any general conservation strategy for software-based art. However, given the current trends surrounding post-digital arts production and the rising enthusiasm for bringing data into the real world, it is not surprising that artists manipulating data within their practice are increasingly interested in developing processes which translate their born-digital creations into tangible forms within physical space. Although such artefacts are often very similar to traditional art objects and can arguably be preserved using standard conservation methods for analogue materials, it should not be assumed that the digital precursors of these creations are redundant and do not need to be retained.

In 2010 I was commissioned to undertake a major research-based arts project for *Manifesta 8: the European Biennial of Contemporary Art*[8] in Murcia, Spain. The resulting body of work, entitled *(in)Remembrance [11-M]*[9] (2010) was a series of interrelated artistic interventions and artworks reflecting on the 11th of March 2004 (11-M) train bombings in Madrid that killed 191 civilians and wounded over 1,800 people. The project was exhibited at the biennial in the Museo Regional de Arts Moderno (MURAM), Cartagena as a site-specific installation within one of the museum's white cube gallery spaces and consisted of various material artefacts interspersed with a few projection/screen-based components.

The exhibition was very well received, and most visitors seemed to categorise and interface with the work as a conventional – not a digital or new media – contemporary arts project. Although each of the separate elements comprising the installation could be related to a traditional visual arts format (such as photography, print, sculpture, video, etc.) and appeared to be far-removed from any digital creation processes, the reality was quite the opposite. Over a year-long period of research, I had data-mined source materials pertaining to the 11-M attacks from numerous Internet-based public and news media repositories in order to compile an extensive digital archive consisting of approximately 12.5GB of data and nearly 8,500 individual files. This archive was then used to formulate all of the installation's eight bespoke components by algorithmically processing various portions of its data into digital forms that could be rendered into physical objects within the gallery space.

[8] http://www.manifesta.org/
[9] http://www.takeo.org/nspace/2010-(in)remembrance_11m/

Figure 7. Installation views of *(in)Remembrance [11-M]* at *Manifesta 8: the European Biennial of Contemporary Art*, Region of Murcia (Spain) in dialogue with Northern Africa, curated by Chamber of Public Secrets (Alfredo Cramerotti and Khaled Ramadan with Rían Lozano) and funded by the Manifesta Foundation, Museo Regional de Arts Moderno (MURAM) Cartagena, ES, 2010. Photographs by Nikolaus Schletterer.

The project's source data archive and many algorithmic processes provided the fundamental basis for the artwork to such an extent that if any of these software-based elements were withdrawn, it would not have been possible to synthesise any of the exhibited artefacts. For example, one of the works included in the *(in)Remembrance [11-M]* installation was a large collection of black and white photographic prints displayed atop a long rectangular white plinth in the centre of the gallery space. These prints showed various remediated images relating to the 11-M attacks and were produced from a set of several thousand digital photographs contained within the project archive. These photographs were uniformly batch-processed with a custom algorithmic protocol that generated a series of master images which were then output to thousands of physical 7x5" prints via a commercial digital photographic lab service. In the installation, the finished prints were arranged in a seemingly random manner that encouraged visitors to peruse them and choose some to take away. Over the three-month exhibition period the selection of prints changed on a daily basis as visitors removed them from the plinth and gallery attendants replenished the assortment.

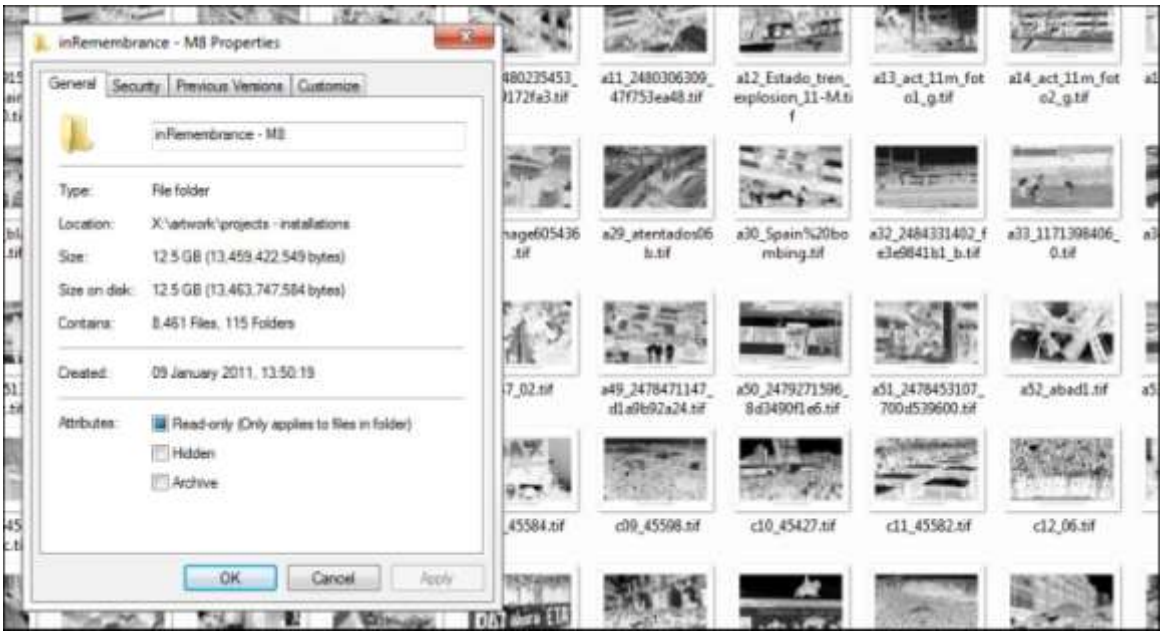

Figure 8. Material vs. digital artefacts: the 12.5GB data archive of the *(in)Remembrance [11-M]* project.

In terms of preservation, is it the analogue or digital form of these prints that represents the true artefact? Is it more important to retain the physical photographic prints that were specially created for and displayed within MURAM since their exact material qualities could never be perfectly reproduced; or is it the master set of digital files that holds the most practical (and perhaps conceptual) significance since it could be used to generate a new version of the work at some future point in time?

Another, even more complex example from the *(in)Remembrance [11-M]* body of work is a series of five photo-mosaics that also comprised part of the installation. As with the photographic prints, the photo-mosaics were exclusively created from the source data archive. The digital files were algorithmically assembled from a library containing thousands of image tiles created from news media photographs showing the immediate aftermath of the bombings. Over the sequence of five photo-mosaics, the tiles became smaller and greater in number, and gradually composited a picture of a 11-M remembrance shrine that had been taken by a member of the public and posted on *Flickr*[10]. Each finished photo-mosaic was then incorporated into an intricately designed broadsheet layout and exported to a standard print-ready PDF format for litho printing. The set of PDFs were given to the newspaper *La Opinión de Murcia*[11] to sequentially publish as full-page prints over a five day period. At the end of each publication day, I ventured into the city and retrieved a single copy of that day's print from the garbage. I then returned to the museum with the copy, signed it, encased it within a museum-quality frame and added it to the installation.

With regard to this piece, again the question arises as to what constitutes the actual work that needs to be preserved. Is it the digital source files such as the TIFF photo-mosaics or the PDF page designs? Is it the physical artefacts like either the several hundred-thousand mass-produced newsprints or the single degraded copy that I retrieved and signed? Or perhaps, is it the sum of the artistic process itself that now only persists within stories and documentation surrounding the project?

[10] The original picture has since been removed from *Flickr*.
[11] http://www.laopiniondemurcia.es/

Case Study IV: blending virtual, physical and networked spaces

The challenge of preserving artworks consisting of both analogue and digital elements becomes further complicated when notions of variable space and time are layered into the creative process. As individuals are increasingly fascinated with extending their digital lives across a growing range of virtual and networked environments made possible through the latest technologies, it is logical that many artists working within the digital domain have adopted similar approaches within their practice.

Although the production of mixed-reality artworks constructed from varying combinations of virtual, physical and networked space coming together in real-time is not a 21st-century development, the launch of the online 3D virtual world product *Second Life* in 2003 by Linden Lab opened a seemingly infinite range of new possibilities for artistic exploration in this area. In February 2008, Turbulence[12], a leading international portal and commissioner of networked art, curated a seminal exhibition and symposium, entitled *Mixed Realities*[13], that showcased five artworks which simultaneously engaged visitors across *Second Life*, a traditional gallery space and the Internet. Collaborating with two of my long-standing colleagues, Drew Baker (Research Fellow in the Department of Digital Humanities, King's College London) and David Steele (Senior Technical Consultant based in Arlington, Virginia), I was awarded a commission to create a new work for the show. Our project, entitled *The Vitruvian World*[14] (Takeo/Baker/Steele, 2007), combined my ongoing interests in using *Second Life* as platform for mixed-reality art with Baker's expertise in 3D modelling within virtual worlds and Steele's extensive knowledge in advanced web programming and architecture.

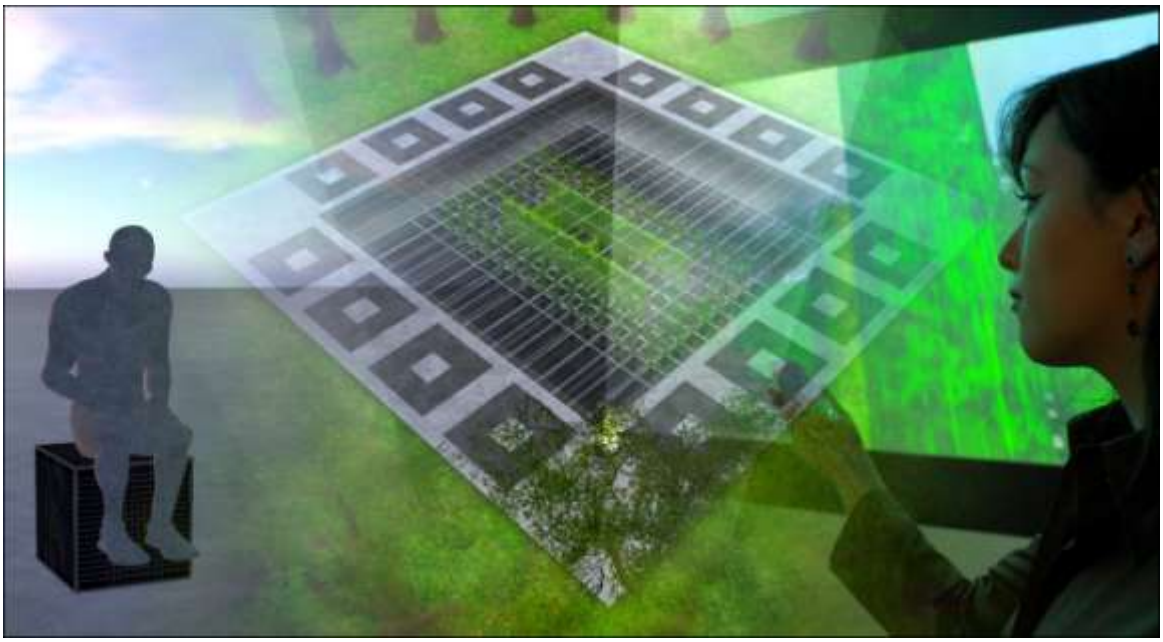

Figure 9. Blending virtual, physical and networked spaces: *The Vitruvian World*, with Drew Baker (academic research, *Second Life* modelling and programming) and David Steele (network design, server-side programming), commissioned by Turbulence.org with funds from the Andy Warhol Foundation for the Visual Arts, 2007.

[12] http://www.turbulence.org/
[13] http://www.turbulence.org/mixed_realities/
[14] http://www.turbulence.org/Works/vitruvianworld/, Cf. Magruder 2009c.

The Vitruvian World was a multi-nodal installation based upon the architectural theories and principles of the 1st-century B.C. Roman architect, engineer and writer Vitruvius. Using Vitruvius's formulae for ideal temple construction contained within his text *De architectura/Ten Books on Architecture*, we devised a mixed-reality artwork that interconnected the three distinct spaces. Within the virtual environment of *Second Life*, we transformed a full 256m^2 public simulator (sim) of land into an aesthetic realm made from 'natural' and 'architectural' features that were precisely built and arranged according to Vitruvian proportions. The synthetic landscape and its contents existed in a continuous state of change as the objects within the world responded to the presence of visiting avatars. In the architectural centre of the realm there was an enclosed area containing a lone human form that seemed to be made from the same material as its surroundings. This *puppet* body was linked to the physical gallery space and could be controlled by real world visitors to the exhibition. The *puppet's* audiovisual senses were rendered in the gallery as a high-definition corner projection and surround sound environment that would immerse the user and allow them to explore the realm. A third type of figure was also located within the virtual world, hidden beneath the ever-shifting landscape. This inanimate *doll* was devoid of human agency and only existed to document the passage of time within the space. The *doll's* aerial view of the virtual realm was captured and transmitted across the Internet to a server-side application that processed the live data stream into sequential images which were then reconstituted into an algorithmic (Flash) video montage. This ever-changing piece of networked art was projected in the gallery exhibition and accessible on the Turbulence website, and allowed both local and remote passers-by a chance to observe remediated 'painterly' glimpses of the virtual world before the data was then reflexively looped back into *Second Life* and aesthetically layered onto the area of the virtual landscape being recorded by the *doll*.

Given the proprietary, closed nature of *Second Life* and the draconian terms and conditions of service imposed by Linden Lab, it has always been unclear how projects created within the platform might be fully preserved. In terms of the virtual forms, compositional elements of *Second Life* creations like geometry, textures and scripts are notoriously difficult to successfully extract from the system, and such processes are usually dependent on having full permissions on every aspect of every item within a targeted build (a highly unlikely scenario considering that building in *Second Life* is based upon a collaborative and 'buy-to-use' mentality). Potential solutions for securely archiving *Second Life* content do exist – most notably the open source 3D application server *OpenSimulator*[15]– but these options have yet to be adequately explored by the wider research community. Additionally, if an artwork is also partially comprised of physical and networked spaces and layers that exist outside of *Second Life*, the situation (and its effect on preservation) becomes exponentially more complex.

[15] http://www.opensimulator.org/

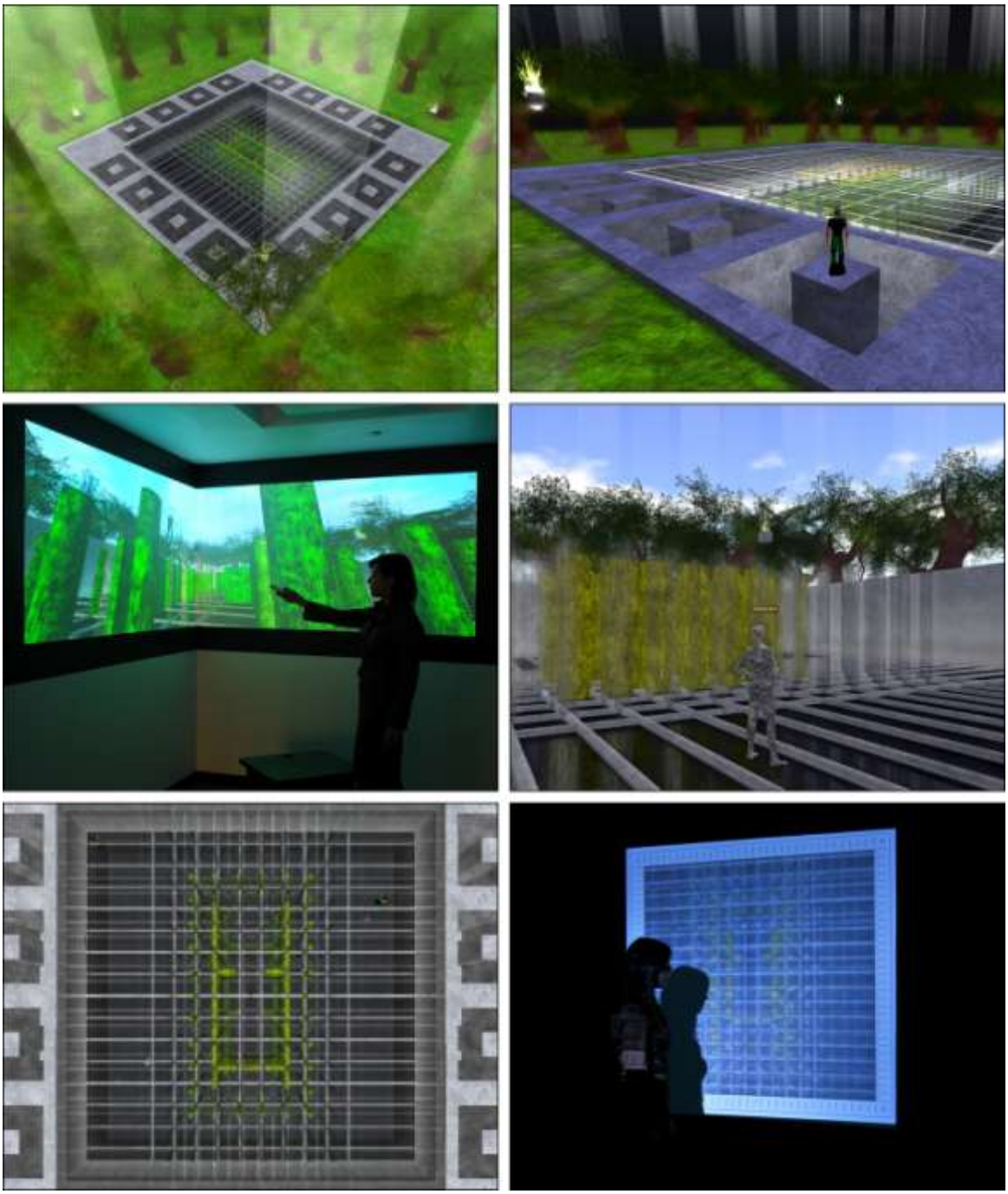

Figure 10. The need for preservation across multiple realities and environments: (from top to bottom) the virtual, physical and networked components of *The Vitruvian World*.

To further complicate matters, the appeal and impact of artworks like *The Vitruvian World* are hugely related to their innovative approach and placement at the forefront of current artistic-technological boundaries. These projects will consequently require a sense of historical context in order to be fully appreciated once their leading-edge qualities become outdated. However, as *Second Life* is a 'living' metaverse that is defined in many ways by social activities and conventions which evolve at a much faster rate than in real life, it can be extremely difficult (and sometimes impossible) to capture these contextual aspects before they change or disappear.

For these reasons, the residual legacy of many art projects using *Second Life* is often limited to documentation. But can even a comprehensive collection of images, stories, videos and other relevant materials properly communicate the conceptual, technological and aesthetic intricacies of these kinds of ephemeral works? Can such traces be used to reconstruct or at least re-imagine the actual artistic experiences that they provided? If not, and given the apparent lack of other viable options and strategies at present, must it simply be accepted that such artworks cannot be adequately preserved at this point in time?

Case Study V: integrating time-based, collaborative content

The rising use of virtual environments like *Second Life* as platforms for artistic practice is not surprising given the vast creative possibilities that they offer. One of the most exciting aspects of these systems is an underlying social dimension that in many ways exemplifies the collective ethos of current online culture. Within these realms, communities of users regularly collaborate on numerous activities ranging from the generation of in-world content and resources to the production of virtual performances and serious games[16]. For artists creating work within such settings, the emphasis on individual effort is often replaced with a focus on group relationships and achievements. As a result, traditional standards based upon the notion of a sole creator have become outmoded since they usually lack the facility to properly acknowledge the varying contributions of multiple individuals working towards a common goal. Given that issues concerning authorship and ownership greatly inform any conservation strategy for art, careful consideration must be given to understand how these factors might alter the preservation requirements for artworks created within such collaborative frameworks.

Changing Room v1.0[17] (2009) is an example of a collaborative art installation reflecting on the transitory nature of mixed-reality environments and the creative potential of working within these liminal spaces. The artwork was undertaken in partnership with Eastside Projects[18], a leading contemporary arts venue based in Birmingham, UK with an international reputation for producing highly experimental exhibitions and events. *Changing Room* linked the organisation's real-world premises to a virtual simulacra constructed in *Second Life* in order to facilitate the curation, realisation and documentation of distinct – yet interrelated – art projects arising from a common pool of virtual and physical resources. Over a seven-week period, a group of resident artists were invited to use the environments and materials to create works of their own conceptual and aesthetic design. Each project lasted for a single week, after which, the spaces and communal assets were handed over to the next artist for repurposing.

Changing Room's primary virtual component was a set of 128 translucent green columns located within Eastside Projects' virtual gallery. Each column was constructed from a single primitive object (prim) that could be fully modified using the standard in-world toolset. Resident artists were given exclusive rights to transform and programme these digital structures, but could not generate their own objects within the space. If any of the artwork's prims were deleted or removed from the area, a series of scripts would instantly regenerate them in their original state.

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[16] The term for game-like simulations that have been designed for purposes other than pure entertainment.
[17] http://www.takeo.org/nspace/sl004/, Cf. Magruder 2011.
[18] http://www.eastsideprojects.org/

The installation's corresponding physical environment was situated in Eastside Projects' second gallery and was constructed from recycled materials that had been collected from the organisation's previous exhibitions. Live audiovisual feeds from the virtual world were streamed into the physical space and displayed on a large projection setup and set of three LCD screens. Visitors entering the physical gallery were tracked by a hidden motion sensor that relayed its data to the virtual realm. The presence of spectators in the physical space caused translucent blue spheres to be generated within the virtual world. Resident artists could use these prims as additional building materials within their projects, however, as each sphere only had a 12-hour lifespan, they would soon disappear and leave no trace of their existence.

Figure 11. Physical installation view of *Changing Room v1.0*, created with the assistance of Drew Baker (*Second Life* programming), curated by Gavin Wade and funded by Arts Council England's *Digital Content Development Programme*19*,* Eastside Projects, Birmingham, UK, 2009.

As the project's lead artist, I constructed and exhibited the artwork's initial configuration for a period of one week, after which I relinquished control over the virtual and physical resources to the first resident artist who then continued the process. In terms of documenting the installation, at the conclusion of each artist's session, photographic, video and textual materials were collected both virtually and physically. In addition, an exact copy of the 128 permanent prims was captured in order to archive a 3D 'snapshot' of the artist's virtual creation.

Although these archived states can be perfectly preserved and reformed within the virtual world (as long as *Second Life* persists), they lack most of the important artistic qualities that I associate with the installation. These arrangements of virtual objects do not communicate how the individual projects slowly evolved over time, nor do they relay any sense of the complex interrelationships between the artists' works. Likewise, the fundamental connection to the physical environment and its material contents is lost. As

[19] http://www.dcdprogramme.org.uk/

such, the more traditional documentation assets collected by the participants provide a far more compelling representation of the total project. If documentation can more accurately embody an artwork's significance, is it the actual digital artefacts of that work which should ultimately be preserved?

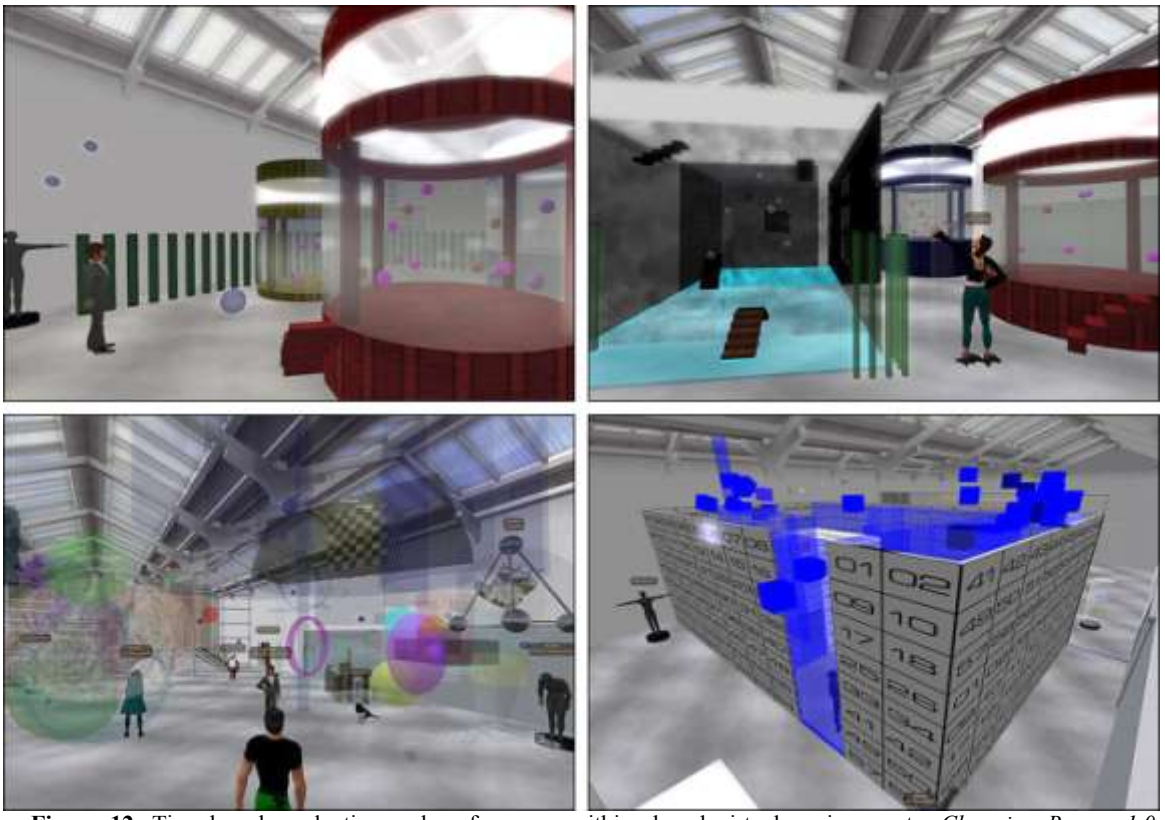

Figure 12. Time-based production and performance within shared virtual environments: *Changing Room v1.0* sessions by (top left to bottom right) Antonio Roberts (as 'Overload Afterthought'), Selma Wong (as 'Selma Zeplin'), Ana Benlloch (as 'Ana Vemo') and Lee Scott (as 'lee85 Unplugged').

Another serious consideration in preserving an artwork like *Changing Room* relates to its profoundly collaborative nature. Although I conceived the project and therefore have been designated as the artist who 'owns' the overall intellectual capital of the work, if the contributions of the six other participants were to be removed, then the artwork would not exist. Furthermore, as I had requested my collaborators to realise their own independent ideas within the overarching environment that I had envisaged, is my role in the project actually more akin to that of a curator supporting the creativity of others within the context of a live event? If so, should a preservation strategy for the project be founded upon methods that are more suitable for archiving exhibitions and performances than individual artworks?

Case Study VI: creating within interdisciplinary contexts

The integration of emerging virtual world platforms and technologies within practice-based research is not unique to the arts, but rather, has permeated numerous other academic disciplines and contexts. As a consequence, such environments have brought together a wide range of individuals with a variety of interests and expertise. Given this situation, it is not surprising that artists working within these spaces have begun to engage

in new types of collaborations with practitioners not normally associated with contemporary arts practice.

In 2010, I was commissioned by the organisers of the *Digital Humanities* conference in London to realise an interdisciplinary project that would explore creative collisions and collaborative possibilities between contemporary arts discourse and digital humanities scholarship. I chose to undertake this work with my close colleague Dr. Hugh Denard (Lecturer in the Department of Digital Humanities, King's College London), a specialist in Greek and Roman theatre history with interests in using advanced visualisation technologies within academic research.

Over an intensive three-month period of dialogue and exchange, we conceived a site-specific installation for the event that conjoined my long-standing use of real-time virtual environments as platforms for artistic expression and Denard's extensive research concerning the playfully illusionistic and fantastical worlds of Roman fresco art. The resulting artwork, entitled *Vanishing Point(s)*[20] (Takeo/Denard, 2010), was a virtual/physical project that blended the principles of ancient Roman art with digital virtual worlds in the idiom of stained glass.

Figure 13. Physical installation view of *Vanishing Point(s)*, with Hugh Denard (academic research), curated by Prof. Harold Short and commissioned by Digital Humanities 2010, The Great Hall, King's Building, London, UK, 2010.

In designing the primary virtual component of the installation, we drew upon the conceptual and compositional principles of theatrically inspired Roman frescoes to compose a classically influenced virtual garden that occupied an entire public sim within *Second Life*. The synthetic garden was built from a selection of beautifully detailed and intricately constructed 'natural' and 'architectural' elements. A single statuesque *doll* rested atop an ornate pedestal in the centre of a lush expanse of grass, while perfectly positioned arrangements of trees and sculpted hedges were framed between a pair of grand colonnades receding towards the horizon. Visiting avatars could wander within the space and relax in the company of strutting peacocks and small doves resting in the light of the artificial sun.

[20] http://www.takeo.org/nspace/sl005/

Figure 14. Screen captures of *Vanishing Point(s)*' 'living' virtual garden and forest, created with the assistance of Drew Baker (*Second Life* modelling), 2010.

The artwork's physical manifestation was embedded within the Great Hall of the Grade I listed King's Building created in 1831 by English architect Sir Robert Smirke (1781-1867). A scenic view of the virtual landscape was captured by the *doll's* gaze and saved as a single ultrahigh resolution TIFF image that was used as the primary source material for the real-world installation. The digital image was algorithmically processed and divided into plates conforming to the 108 rectangular window panes of the Great Hall's end wall. These image files were printed onto *Duratrans* (a large-format digital transparency film) and attached to the individual windows in a manner reminiscent of the spatial-pictorial traditions of stained glass. *Vanishing Point(s)* supplanted an elegant, uncanny view of the virtual garden into the enclosed urban space between the King's Building and the adjacent East Range. The work called upon the daily rhythms of natural light to animate, through the semi-translucent film, a magically poised moment, while the composition's subtle framing elements teased viewers with playful elisions of physical and virtual space.

As with the other previously discussed case studies, it is debatable what should be considered the primary form of the artwork. In this instance, is it the virtual garden landscape that still (for now) exists within the 'living' metaverse of *Second Life*; the digital set of large-format images and derivative plates that are currently stored within the project's data archive; or the physical site-specific manifestation in the Great Hall that will remain until it is removed or the *Duratrans* degrade? Furthermore, even if it is decided that these three discrete elements are all part of the actual artwork and will therefore be adequately preserved, what about the underlying humanities scholarship that fundamentally relates to the piece? Given that Denard's in-depth research concerning ancient Roman wall painting directly informs the artwork's core concept and compositional structure, is not such an important contextual aspect inherently part of the complete work? If so, can the preservation of an artwork like *Vanishing Point(s)* still be considered from only an arts perspective, or must it embrace a more interdisciplinary approach that reflects the project's non-arts related discourses and hybrid research nature?

Figure 15. *Vanishing Point(s)'* research-based context and provocation: (left) 3D existing state reconstruction of the Villa of Olpontis, Room 15 and (right) a 2D virtual restoration of its east wall fresco by Martin Blazeby. Courtesy of King's Visualisation Lab, 2011.

Conclusion: retaining the essence of 'digital' art

Although I am an artist whose practice is absolutely dependent on digital media and processes, in reflecting upon issues of preservation, I keep returning to the thought that it is not really the software or the hardware aspects of my projects which truly define my work. Of course these elements are crucial, and without them, my art would simply cease to exist. But even though my creations use technology, the essence of what they are resides well beyond the sum of their digital parts, and for this reason, I feel it is vital to carefully consider the greater nature and significance of the artworks themselves.

If any path of artistic creation begins with concepts and ends in outputs, there will be various structures and contexts along this sequential journey that certainly need to be retained. For artists like myself, many of these will indeed be digitally-based, but undoubtedly many others will not, and as such we must be mindful not to take a technologically deterministic approach to conservation that inhibits us from securing all the essential ingredients – both digital and non-digital – that comprise the artworks we are attempting to safeguard.

The protection of art for future generations must surely be the ultimate goal of any dialogue concerning preservation. Given the considerable challenges faced by those seeking to preserve today's digitally-based art forms, perhaps initiatives like the *Preservation of Complex Objects Symposia* can sustain a common forum that not only acknowledges, but more importantly, potentially establishes a collective foundation for realising practical solutions which will provide the means to help save these legacies of our contemporary digital culture.

Acknowledgments. I wish to express my warmest thanks to my long-time collaborators Drew Baker and David Steele, whose technical expertise and assistance over the last ten years has not only made the production of these and many other artworks possible, but more importantly, has deeply informed my approach to using computational media.

References

Magruder, M. Takeo, Baker, D. and Steele, D. (2007), The Vitruvian World [artwork], http://www.turbulence.org/Works/vitruvianworld/. Accessed 1 April 2012.
Magruder, M. Takeo and Denard, H. (2010), Vanishing Point(s) [artwork], http://www.takeo.org/nspace/sl005/. Accessed 1 April 2012.
Magruder, Michael Takeo (2009a), Data_Plex (economy) [artwork], http://www.takeo.org/nspace/ns031/. Accessed 1 April 2012.
—— (2009b), Changing Room v1.0 [artwork], http://www.takeo.org/nspace/sl007/. Accessed 1 April 2012.
—— (2009c), 'The Vitruvian World: A case study in creative hybridisation of virtual, physical and networked space', in Franziska Schroeder (ed.), Performing Technology: User Content and the New Digital Media, Newcastle: Cambridge Scholars Publishing, pp. 51–71.
—— (2010a), (in)Remembrance [11-M] [artwork], http://www.takeo.org/nspace/2010-(in)remembrance_11m/. Accessed 1 April 2012.
—— (2010b), Data Flower (Prototype I) [artwork], http://www.takeo.org/nspace/ns034/. Accessed 1 April 2012.
—— (2011), 'Transitional space(s): Creation, collaboration and improvisation within shared virtual/physical environments', International Journal of Performance Arts and Digital Media, 7:2, pp. 189–204, doi: 10.1386/padm.7.2.189_1.

In Homage of Change

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Introduction

As artists we build on a heritage that extends back over millennia. However, many aspects fundamental to our practice trace their origins to the more recent detonation of the first atomic bomb at Hiroshima. The Manhattan Project was the code name for a research program that produced the first of only two nuclear bombs ever to have been detonated in war. Significantly, it was also the first serious use of computer modelling. The natural world is a beautiful place and we humans have spent our entire history struggling with its complexity. This struggle took a massive leap forward in the years following the Second World War, as the relevance of computers expanded beyond the domain of code cracking and bomb building, to offer insight into almost every aspect of nature's wonderful mystery. Computers and computer modelling are now fundamental to our artistic practice.

Swords to ploughshares

There are many riddles of nature that are best understood through computer modelling. For example the ability of unintelligent ants to solve complex problems; like finding the shortest route between two points. The simplicity of the rules required to solve what scientists call shortest path optimisation has not only been revealed by computer modelling but has become a field of research in its own right. As we started our career, the computational tools necessary for this type of study were, for the first time, freely available to artist like ourselves. We, too, had a fascination with the complexity that exists in natural systems and were keen to find a deeper way to embrace this in our practice. We did not wish to create mere representations of the fascinating forms that exist in nature. We were moved by the way forms, behaviours and patterns come into being and appreciated how the techniques and tools, used by scientists to understand the natural world, were equally relevant to us.

In many ways our practice builds on established practices of artistic endeavour taking at its centre the observation and study of nature. However, we incorporate in all our works the power of computer modelling to go deeper than the surface image into the mechanics of nature's intricate systems. As a consequence our art-works rely on technology both for their production and display. This move from canvas to code has significant ramifications both for the creative process and the life of artworks once they leave the studio. Before we struggle with the problems this adds to conservation, let us first explore the relevance of this medium to our practice.

Computational death and renewal

The diversity present in nature is staggering. In the order Lepidoptera alone, over 600 new species are discovered each year. Those who perceive the value of diversity are rightfully mindful as extinctions erode its reach. Separate from those extinctions arising from our selfish exploitation of the planet are those that form the natural process of evolution. All the diversity that currently persists is a consequence of countless annihilations in the endless competition between species. This natural process of change informs many of our artworks.

With scientists we share both a fascination for the mechanisms and processes that create this rewarding diversity and our use of computational technologies. Many of our artworks model the behaviours and growth of imagined beings which through their artificial lives explore a similar diversity to that found in nature. The artificial life-forms represent a study of a narrow facet of diversity – they live and die with each new instance exploring a seemingly infinite range of song, colour, form and pattern. Because their ability to change is constrained, they will always look recognisably similar. Like the order Lepidoptera they present a vast amount of diversity whilst maintaining an overall visual consistency. Within this tiny slice of diversity there are still more possibilities than anyone could view in a life time.

As we view these artworks we witness a process - liquid, uncertain and irresolute. A familiar process, as change is more a part of contemporary life than ever before. We understand the world not as a stable constant but as fluid, dynamic and unpredictable. We thrive on the richness and excitement change brings, pausing occasionally to worry. For there is a tension, a fear. We appreciate more than ever before the messy conflict between our accelerating pursuit of the new and anguish over its consequences. Computers allow us to place this battle at the centre of the creative process; making works that are not safe, fixed and stable but that reflect the complexity and conflict in the world around us. Significant to this approach is the move from rigidity to fluidity. Here our concern is not in maintaining what is present but allowing the freedom necessary for flux. In contrast to many artworks that exist as static moments, time becomes the dimension through which the work lives and breathes. Even we the authors are not sure what form they will take, finding ourselves shift from creator to spectator as we watch some unexpected event unfold.

Restless concerns

In 2005, we created our artwork Biomes (Fig. 1), a series of computational systems that use artificial life algorithms to remain open to change. The life-forms in the Biomes use a rule based system to form intricate patterns on their bodies. The rules are generated randomly from a vast range of possibilities so each life-form viewed is unique. We value the life this brings to the Biomes - adding surprise with a procession of new forms. This excites us but there is a price to pay. The more freedom we give the artworks to change, the greater the chance for unexpected outcomes. We invest a lot of time testing to ensure the artworks will run for extended periods without problem. We balance the reward of freedom with the risk of collapse, erring on the side of caution. Despite our every effort, complex systems can have emergent properties that, like the weather, are impossible to predict in the long term.

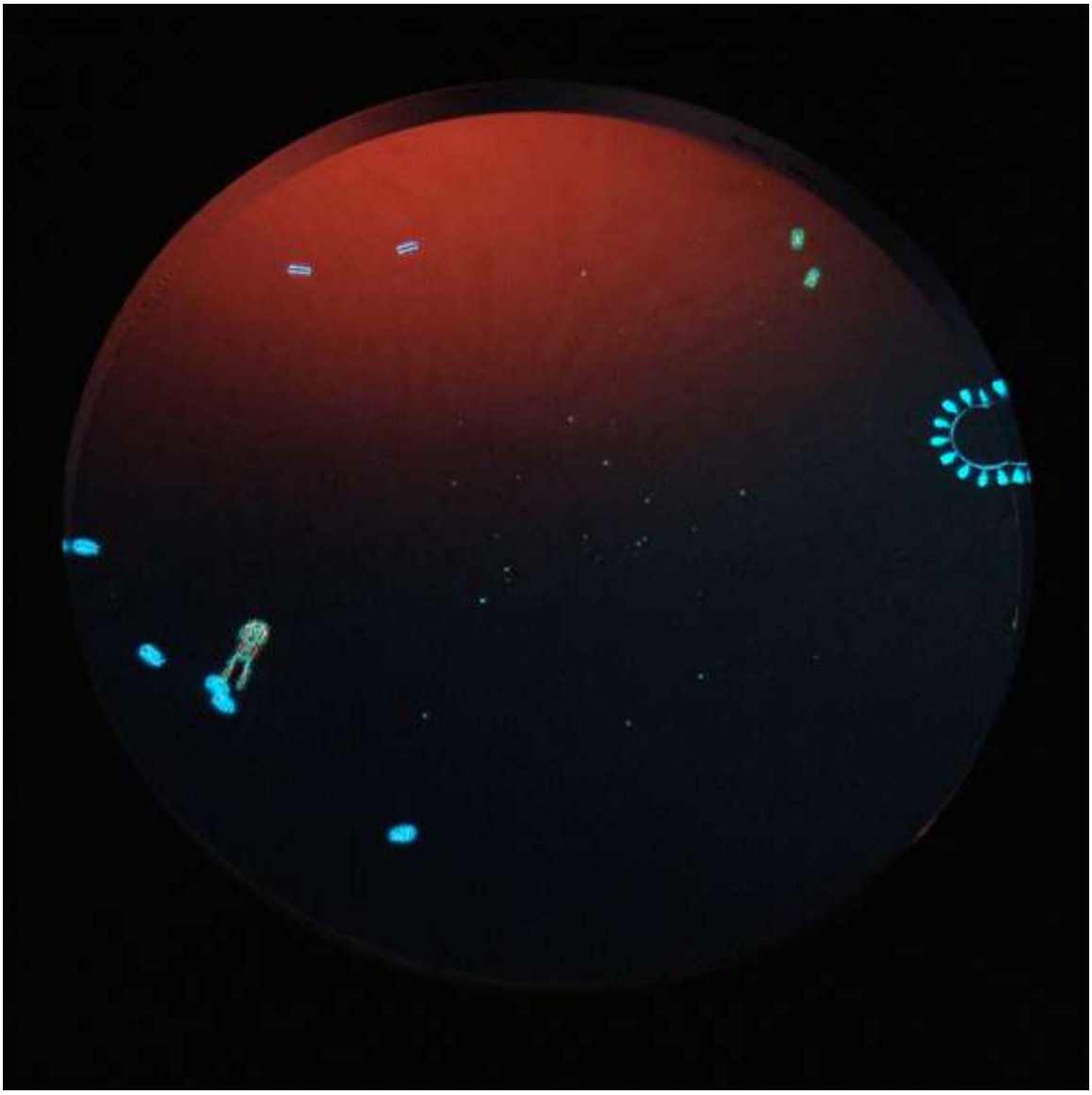

Figure 1: Biome, image of the computational artwork 2005

The life-forms in the *Biomes* have natural cycles of activity, not dictated by us, but emerging from their behaviour. Normally this alternates from moderate periods of tranquility to intense action. Time spent testing assured us this range was within bounds that would make for a rewarding experience. There was, as we later discovered, the possibility for the work to slip into a mini ice age of inactivity. This, albeit rare occurrence, illustrates the risk of allowing independence and autonomy in an artwork. Some see a fascinating and fitting expression of complexity in a life like system, others an undesirable bug. In the studio we are concerned with realising the creative possibilities of fluidity, handing works over to a collector or a gallery we are faced with the paradoxical challenge of preserving artifacts that are made to change.

> *This art does no longer hold on to the safe properties of the final object, the ultimate manifestation of a creative process. In its production, it responds to the major shift from an industrial culture based on the concept of the final product to a post-industrial, networked culture. It explores the variety of form and behaviour of systems and objects without limiting itself to the rules of an art market that favours the single specimen. Becoming more work-in-progress than finalised matter, this art bears the possibility of the infinite series, of the unfinished and open-ended oeuvre. (Jaschko & Evers, 2010)*

The dynamic nature of this work fidgets nervously in the quiet of the unchaining gallery. Presenting artworks within this context allows us as viewers to perceive the works as stable. The clinical white space, like the inside of a refrigeration unit, reassures us that its contents are safely preserved. This image is misleading - things change, varnish yellows, inks fade, paper oxidises. Change, but all beyond the casual perception of the viewer. In contrast, the sign apologising that a digital exhibit is temporarily out of order, also begs pardon for rupturing this sense of stability. A computer's hard drive does not fade or yellow, it dies - sudden, abrupt, blank. Having worked with a public collection, we are fully aware of the activity beyond the viewable galleries; ensuring the public enter an exhibition where everything seems ordered, fixed and permanent. How do we rationalise these two conflicting worlds? Do we ensure that works are made to accommodate the desire to preserve or do collections embrace the nature of change and variance? Is the frozen gallery no longer relevant in our frenetic changing world?

Time is the devil

> *David Hancock, chief of the Hitachi Corporation's portable computer division, drove his team with the slogan "Speed is God, and time is the devil." Software product cycles, already short at eighteen months to two years, have begun to evaporate. Instead of distinct, tested shrink-wrapped versions of software, manufacturers distribute upgrades and patches that change within months or even days. (Gleick, 1999)*

As I type this quote, another Java update beckons me from the task bar, reminding me that I am out of date, again. I often wonder how many developers are pounding away at their keyboards in order to produce such an unrelenting stream of revisions. Does this affect the expectations of those commissioning, purchasing and exhibiting digital art? The pressure to make work robust enough to survive beyond the studio boils over in the last moments before an exhibition deadline, as we endeavour to resolve any last moment glitches. But is this work finished, or the first release; Beta 0.0.1? In addition to facing the same challenges as the software industry we also need to interface with the established arts institutions. Do they imagine we, too, have a team of developers, working on update after update? The speed, at which the wheels of technology spin, does little to ease our hurry sickness as we struggle to keep up. Product cycles are equally nauseating as they rush out new hardware models, bigger, better, faster. A specific monitor or motherboard may no longer be commercially available before the work has even left our studio. What about spares and repairs? Some of our artworks have already outlived the natural life of their computer hosts. In the intervening years the shifting sands of software and hardware have added complexities to this problem. In almost all other commercial situations, revisions and upgrades are produced to support the latest hardware. In the art world it is normal practice for public collections to trawl eBay, hunting down and archiving an ever diminishing stock of redundant technology to preserve hardware dependent art. Surely

this can only delay the inevitable? Even so, we can increase the longevity of software art as we learnt with one of our early computational artwork System 1.6 (Fig. 2). This generative animation creates its own sound score through the interactions of a large number of digital creatures.

Figure 2: System 1.6, a detail from a screen grab of the computational software 2001

To achieve fluidity in this artwork, we had to optimise, cut corners and find compromises; pushing the boundaries of what was possible on the chosen platform and hardware. In our attempt to squeeze every last cycle from the processor, we set everything to run as fast as possible. This was a race we could not win. Within a couple of years technology thundered passed. Appearing from the dust cloud left in its wake were our creatures, whizzing about manically at supersonic speeds far beyond our intention. This simple blunder, easily corrected with a single line of code frame rate (30); reminds us we are not the only authors of change. We have to follow good programming practice to ensure the future of our work, if not for future generations at least for future presentations.

We are not the first to make this mistake. In Carl Honoré's book In Praise of Slow he talks of a small group of musicians who think we play classical music too fast. Many of these rebels belong to a movement called Tempo Giusto. They believe that at the start of the Industrial Revolution, musicians started speeding up with the accelerating pace of life. Speed and dexterity, of virtuoso performers gave them the edge, but resulted in a gradual acceleration. Many believe works of composers like Beethoven are now played too fast.

> *But surely the great composers laid down what they considered the "right" tempo for their music? Well, not exactly. Many left behind no tempo markings at all. Almost all the instructions we have for the works of Bach were added by pupils and scholars after his death. By the nineteenth century, most composers denoted tempo with Italian words such as presto, adagio and lento – all of which are open to interpretation.(Honoré, 2004)*

Some feel even if these works should be played slower, doing so is pointless as we are geared up to experience life at an accelerated pace. Slowing down would simply make them lose relevance. Considering the fluid adaptable nature of digital art, to what extent should we honour the author's original intentions? Is it acceptable for future audiences to tinker with the tempo, finding what feels right to them?

Disentangling the art from the architecture

In the same way recordings of musical performances provide additional documentation, video documentation of computational works could likewise help. However, as these works change and morph, never repeating, this only captures how the work once appeared rather than how it should be. Contrary to increasing the clarity of documentation, we have grown comfortable with the intrinsic plastic nature of the medium. Over time, we have increased the number of preferences, allowing flexibility after authoring; after the point at which convention encourages us to see the work as finished, correct and definite. On many occasions we have been unable to resist temptation, opening and fiddling with these parameters. In order to preserve work of this nature one must disentangling the definite from the malleable.

Not only do we wish to leave some aspects of our artwork free and unbound, the very nature of the medium makes it impossible to cement the visible expression of the work. Lurking in the shadowy corners there is a deceit which we will explore through our recent artwork Lost Calls of Cloud Mountain Whirligigs (Fig. 3).

The whirligigs are imaginary beings that inhabit the peaks of a craggy mountain. They swish their long plume like tails as they propel themselves around their world with intricately patterned propellers. Tired the whirligigs come in to roost, extending a single arm to grab wires that span the view. From these wires they hang and rest, occasionally singing their melancholy songs, with chirps that emit puffs of luminous smoke. Curling tails tightly around their bodies, they slip into a deep sleep, replenishing spent energy. This is what a viewer sees but it is not the work. In the same way the nuclear detonation modelled during the Manhattan Project is separate from the bomb that explodes and destroys, a viewer of Lost Calls of Cloud Mountain Whirligigs sees an expression of the work made by a machine. A reflection or mirage that has the potential to distort. The whirligigs we made are abstract in the form of a computer model. Everything they can and will do is a product of this description - absolute, precise, even though the expression itself can be complex, messy and unpredictable. Each whirligig has values embodying every aspect of its being. Anything not represented by a discrete symbol does not exist. One number represents how much its tail is curled, another, how much it should be curled. Every cycle the tails actual curl is adjusted by 0.125 times the difference between these values. Never more, never less. Every grain of a whirligig being is manipulated using the same maths we all learnt at school. The order in which these manipulations take place if described by the model with inexorable precision.

At the level of the model the artwork is the ideal object for conservation, its abstraction allowing the freedom to move from one programming language to another, or even

escaping the computer in favour of paper and pen. After all, the term computer used to be a job description before it became a machine. Depending on ability, it might take days to compute one small moment in time, but it could be done.

Figure 3: Lost Calls of Cloud Mountain Whirligigs (view left & right), a screen grab from the computational software 2010

A haze develops as we follow the whirligigs on the path from model to screen. Definition is lost between the model and its sustaining software and hardware. At their creation, whirligig body parts are assembled from libraries of images. These source images share the stability of all digital imagery, being easily moved between formats without change. However, when we composite them into new and unique versions we employ algorithms not described by us. The fog thickens as authorship is shared. These algorithms are part of the open source environment in which we make the work. We could look under the hood to see how each pixel is manipulated. Unperturbed, let us carry on, for you will see nothing unless our whirligigs appear on screen. We calculate locations, rotations and scales until all is ready. Now vanishing in the fog, our atomised whirligigs have their numbers crunched and munched by a library interfacing with the graphics card. Here we lose all sight until, by magic, they materialise on screen. As we make artworks like Lost Calls of Cloud Mountain Whirligigs, we shift back and forth between the model and its expression created by the graphics card. Even we forget to maintain a healthy distinction between them. The model depends on this supporting software and hardware to come alive but can also be separated, uncoupled and transplanted into a new body.

Exploring the possibility of re-authoring one of our early artworks on a different platform, we noticed an improvement to the render quality. The model translated without change but its representation on screen was subtly different. The spinning flowers present in the artwork appeared smoother, more delicate. This was due to the platforms using different render engines - the former DirectX and the later OpenGL. Although fundamentally the same, this small shift in appearance reinforces the separation between model and visible manifestation. How far beyond the bounds of the model must we go to preserve that which is quintessential to a computational artwork?

In order for custody of a work to have true value, a greater range and depth of material should be included with diminished significance given to the compiled software. We feel the artwork is embodied in the source code, extending beyond the model written by us, to encompass the platform and libraries employed. Our departure from Macromedia Director, the platform used to make our early works, was impelled by the restrictiveness of the license and black box concealment of its inner workings. This obstruction prevented us from passing this crucial component of the work into the care of a collection. We now opt for open source platforms allowing us to include not only the compiled software but more importantly the source code for the work, its platform and supporting libraries.

Emancipation

We would like to foster an appreciation, less centred on the tangible fixed and final. In the same way that it would be madness to conserve a piece of music by keeping the performer alive it must surely be equally foolish to rely on archiving and preserving hardware in order to maintain digital artworks. However, artists must carefully consider the extent of material required by a collection, enabling them to effectively embrace the challenges of translating software art for future technologies.

What we need is a new perspective if we are to relax and enjoy the potentials of this exciting medium. We hope here to encourage emancipation from our obsession with the fixed tangible object, that which is traditionally favoured by collectors. In preference, we suggest a philosophy that accepts the complex interrelationships between myriad providers of software and hardware. One which appreciates change as a vital component of life. Hardware like our mortal selves will die but ideas expressed in code that is open and visible can pass uninhibited through successive technologies, like culture, flowing through the generations.

Acknowledgements. National Centre for Computer Animation, Bournemouth University UK; Arts Council of England; [DAM]Berlin/Cologne. All images courtesy of boredomresearch and [DAM] Berlin/Cologne.

References

Gleick, J. (1999). *Faster : The Acceleration of Just About Everything*. London: Litte, Brown and Company.

Honoré, C. (2004). *In Praise of Slow : How a Worldwide Movement Is Challenging the Cult of Speed*. London: Orion Books.

Jaschko, S., & Evers, L. (2010). *Process as Paradigm : Art in Development, Flux and Change*. Gijón: LABoral Centro de Arte y Creación Industrial.

Preserving Interaction

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Introduction

As early as 1992, Brenda Laurel noted that the operation of computers is a performative activity (Laurel, 1993). The use of digital technologies to create interactive and immersive artworks is continually increasing as hardware and software becomes more available and affordable to artists and the conceptual and aesthetic opportunities offered by digital media continue to inspire. Interaction with technology is the virtual and conceptual equivalent of a man walking across Peter Brook's famous 'empty space' (Brook, 1968) and is both performative and ephemeral. In terms of their inherent characteristics, digital arts are very similar to performing arts; artistic experiences that are manifested physically yet do not rely on a static materiality to communicate meaning or emotion, that have a life beyond the moment of their enactment, and that, crucially, require active interpretation and interaction. As such, it is useful to consider interactive artworks through a dramaturgical framework and to draw parallels between their similar challenges for documentation and curation and the preservation of these art forms into the future.

Interaction as performance

Like the performing arts, interactive artworks are characterised by **ephemerality, variability,** and an individual and two-way mode of perception that defines their **interactivity**. Ephemerality refers to time-based enactment and the audiences' experiences of it. Any live or interactive work of art is irreproducible, each experience is unique and cannot be replicated in another space or time, even if both the work's author and the audience/user (or 'spect-actor' to borrow a term from Augusto Boal's Forum Theatre) wishes it.

Variability refers to the separation of the concept of the artistic work from the physicality of its manifestation. Just as there have been many thousands of performances of A Midsummer Night's Dream with different casts, sets, and even text (not one of which can be considered to be the 'original' or definitive performance), the core of software art is typically much more about what it does rather than what it is made out of. Function has primacy over material, performance and behaviours are more important than format. This reinforces the idea of art as being something you *do*, not something you *make*.1

1 Cf. Richard Rinehart, "Artworks as Variability Machines" and Simon Biggs, "Make or break? Concerning the value of redundancy as a creative strategy" presentations at the Preservation of Complex Objects Symposium (Software Art, Glasgow, 11-12 October 2011) http://www.pocos.org/index.php/pocos-symposia/software-art. Variability is discussed more fully in Rinehart's upcoming book (Rinehart & Ippolito, New Media and Social Memory, 2011).

Interactivity is about a mode of perception that leads to active influence on the artwork. Whilst multiple interpretations of a 'static' artwork such as a film or painting are certainly possible, the artwork itself remains unchanged by these interpretations. Software art often moves the interpretation of meaning outside the mind of the spect-actor and incorporates it as an inherent part of the enactment of the work, with the work itself changing and adapting to user inputs. Depending on the design of the artwork and the technological framework surrounding its delivery, interaction may be crucial to the aesthetics and semantics of the work, or a much more subtle influence. Furthermore, both performance and interactive art are shaped by the audience's tacit knowledge, hidden decisions, and learned behaviours (for example an audience clapping or a user double-clicking). In fact, interaction itself is a performative activity, requiring an audience to willingly suspend their disbelief (deliberately ignoring the technology of the proscenium or computer screen) in order to engage with the work in an active and ultimately rewarding way. One of the principal goals of interactive artworks is to motivate the audience to take action (Utvich, 2004, p. 225).

Interactive art, therefore cannot be defined as discrete objects – the type of computer monitor or a text file containing the code – but as an "arrangement of possibilities" or "sum of possible narratives" (Grau, 2003, p. 205); their ephemeral and malleable nature becomes a deliberate feature of the artwork. The work becomes less about delivering a particular message and instead about creating a system of communication.

> *"Ultimately the creative process itself becomes an open-ended work: production and reception merge into a single, mutually conditioning cycle." (Hagebölling, 2004, p. 16)*

As the framework of the artistic experience, software develops these characteristics further than much of live performance as it can offer a non-linear or segmented, hypermedial experience, often requiring further competencies from spect-actors such as navigation, decision-making, and individual action. The form or narrative of the work may only develop through incremental actions by users, based on individual motivations or by other interactive inputs such as live data streams. It is at these points of interaction that the dramaturgical design of the work becomes most clear. Furthermore, as dramaturgy is a formative, aesthetic, and communicative lens and above all creates the overall experience for the audience, (Hagebölling, 2004, p. 9) it is useful to apply this framework when considering the design of interactive artworks.

Interactive works can also add further layers of narrative and aesthetic complication when making use of networks which can overlay spaces (e.g. two remote users occupying the same virtual space, or a mixture of physical and virtual space), time (e.g. replaying the effect of an interaction long after the user has gone), and identities (e.g. when a user takes on a different character in order to engage more fully with the work). Of course, it is these very characteristics and complexities that make documentation and curation of both performance and interactive media artworks so challenging.

> *"Only fixed artworks are able to preserve ideas and concepts enduringly… an open work, which is dependent on interaction with a contemporary audience, or its advanced variant that follows game theory – the work is postulated as a game and the observers, according to the "degrees of freedom", as players – effectively means that images lose their capability to be historical memory and testimony. In its stead, there is a durable technical system as framework and transient, arbitrary, non-reproducible, and infinitely manipulable images. The work of art as a discrete object disappears." (Grau, 2003, p. 207)*

Complexities of interaction and documentation challenges

Spect-actors experience interactive works through a two-way, iterative process of reception, interpretation, and action. Interactions themselves are extremely problematic to document, as they are typically based on a decision made within the user's brain and whilst techniques exist for documenting the interactions themselves (for example recording mouse clicks, data input, tracking eye movements, or even full body motion capture within 3D environments), it is more difficult to capture the user's intent; why a particular action was undertaken and what sparked that decision.

A deeper understanding of the types of control spect-actors have over technology-based environments can reveal clues about their hidden thoughts and emotions. Taking physical or conceptual movement through a virtual environment as an example, there are three ways in which users navigate through virtual environments: exploration, search, and manoeuvring (Kulik, 2009, pp. 23-25) which can be usefully expanded to interactions in non-Euclidean, conceptual spaces as well.

Exploration in physical or 3D environments is typified by a user 'looking around', frequently changing direction whilst observing his environment. This indicates that the user is covering distances without knowing the target destination. In artworks based on a model of conceptual (rather than physical) navigation, for example, using hyperlinked media, a spect-actor's exploratory behaviour might be similar to Web browsing; a meandering path through the work with frequent observation and assessment of his current situation, and use of navigational tools that support exploration, such as a browser's back button.

Search behaviours result from a user knowing in advance her final destination (or discoverable item) and attempting to find the most efficient route to this specific condition of satisfaction. In movement-based and conceptual environments, a user may 'select' a destination and be taken directly to it, for example clicking a hyperlink or 3D object and being taken to it without the need for manual navigation techniques.

Manoeuvring (which could be called 'investigating' in conceptual environments) describes behaviours which aim to discover more about a particular item. In 3D environments this would be typified by walking around an object, viewing it from different angles or perhaps picking it up and directly manipulating it. In a conceptual environment, a user might investigate the functionality or information presented by a particular discrete part of the work, for example, pressing buttons, reading text, or methodically examining specific parts.

In this example, documentation which records these behaviours and can allow for classification can indicate particular intentions from the interactors from a position of quantifiable knowledge. As mentioned above, techniques do exist for capturing complex data about user behaviours however it tends to be very expensive and time-consuming. The alternative is to embrace qualitative, subjective methods of capturing tacit knowledge, opinions, and intent such as conducting feedback interviews with spect-actors, but this is similarly resource-intensive. Each approach has its own challenges and demands from even the most expert of documenters and the choice of approach (or balance between multiple methods), preparation, and resources required are all factors which need to be considered well in advance.

As well as the fine detail of audience-user interactions such as the examples mentioned above, it is useful to consider an overview of the entire experience that spect-actors have with software art. The concept of **trajectories** has emerged in recent HCI research into interactive applications. A trajectory through an artwork is the whole user experience, the

'narrative' of the work as defined jointly by the work itself and its interfaces, and spect-actor knowledge and choices. Mapping these trajectories of interaction and the reasons why the experience unfolded as it did (i.e. the dramaturgy of the interactive experience) is, again, a serious challenge for documenters.

Trajectories are of course, partially defined by the works and their creative and technological framework; "journeys are steered by the participants, but are also shaped by narratives that are embedded into spatial, temporal and performative structures by authors" (Benford *et al.*, 2009, p. 712). A user can be manipulated into moving at a particular speed through the arrangement of possibilities open to them (one unsubtle example would be a game-like scenario, searching for something against the clock), or even forced to engage with certain elements of the work at certain times (for example, pre-timed events which do not rely on user action to occur or automated control mechanisms which override user actions). Designing how much free exploration of the work an audience can undertake is, of course, part of the process of creating any interactive experience. Trajectories can be applied to spatial and temporal experience, as well as the shifting roles and identities of the spect-actors. For example, a visitor to a gallery could spend some time watching another visitor interacting with a work before making the decision to directly interact herself, using knowledge built through this observation and in turn creating an effect on other spectators (Benford *et al.*, 2005). Many artworks are designed to deliberately encourage this type of passive engagement – and the documentation of these effects adds yet another layer of complexity on understanding these works.

Typically, the creator of an interactive work will have an 'ideal' trajectory in mind for participants: a starting point, an end point which allows the spect-actors to disengage, some experiential goals, and an expected time-range for the process of interacting. Spect-actors can diverge (in space, time, or type of engagement) from the expected path and the creator could choose to encourage divergence or encourage (or even force) them to re-converge, using a variety of dramaturgical or technological techniques built into the interaction design of the software framework.

Defining the essence of interactive works

After centuries of the development of knowledge of conservation sciences, it is easy to fall into the trap of treating the curation of interactive artworks as similar to other pieces of art. In archival terminology, a curated painting must have both authenticity (i.e. it is what it purports to be) and integrity (i.e. it still communicates the basic 'essence' of the original artwork). However, given the inherent variability of software art installations – and the fact that often the essence of the artwork itself exists wholly outside of tangible objects, this object-based approach cannot possibly preserve interactivity. Simply put, there is no single 'authentic' version of a work which depends upon user actions to come alive. Attempts to store interactive works as authoritative, static, self-contained objects that are anything other than examples of the framework of possibilities set out by the software are doomed to failure.

> *"The idea of capturing a static snapshot as a faithful (or even reasonable) representation is somewhat incongruous. Moreover the possibility that one viewpoint or interpretation could be valued over others and presented as the single authoritative account by virtue of being archived is strongly opposed." (Abbott, Jones, & Ross, 2008, pp. 83-84)*

Therefore, the question becomes: how then can we define (and communicate to future audiences) the essence of interactive works? The essence of an interactive work is defined by both the artistic intent of the creator and the implementation of that intent; its physical or ephemeral manifestation. It may rely on physical objects but is not those objects. It may rely on interactions from human users or other actors (e.g. underlying operating systems, real time data streams) but is not those interactions.

Interactions lead to inherent variability at the level of the manifestation of the artwork which must be somehow captured and represented – or at the very least acknowledged – in curation efforts, but too much variability in representations may lead to a loss of coherency and therefore reduce the integrity of the essence of the work. As well as in its ephemeral manifestation, part of the essence of interactive artwork lies in its trajectories of user experience. Appraising what aspects of user experience to capture to most accurately represent the core essence of the work (e.g. enacted actions such as mouse clicks as mentioned above or descriptions of user intent and reactions via feedback) is a very skilled documentation task. Furthermore there are interactions that can affect the aesthetics or function of software art that are not defined by human actors. Machine interpretation of, for example, a section of code is more easily defined, predicted, and repeated than that of human actors, and as such the technical and procedural aspects of curating software art can occlude the other aspects of a work's integrity: its core essence. Again, there is a danger of relying on the heritage of conservation studies and fixating on the curation of the more manageable, tangible and static aspects of the work at the expense of the more difficult (and resource-intensive) but more meaningful representations of essence.

Automated interactions can raise other important issues. For example, *System 1.6*, a work created by boredomresearch[2] showed sprites moving around a monitor screen. The speed of the movements was an important aspect of the work's visual and sonic aesthetic and at the time was limited by the graphical processing power of the technologies used, so in terms of coding the sprites' behaviour instructions were to move "as fast as possible". Enactments of the curated version however have much greater underlying processing power which results in increased speed described by the creators as "comedic" and "manic" (Smith & Isley, 2011). The lack of hard-coded behaviour leads, therefore, to a **reduction** in the integrity of the curated work over time: too much variability. This raises the potentially controversial issue of whether curators should make changes to the components of an interactive work in order to preserve, as best they can, its artistic essence. If behaviour is more important than material and function/interaction has primacy over the code, should a curator edit the original code to enforce a maximum speed closer to the first manifestations of this artwork? Other interactive works draw in external interactions which form an intrinsic part of their essence, for example data from the Internet, gallery environment, or specialist data feeds. Is it necessary to record these data streams alongside other representations of the work (and perhaps to document how the data interacts with the framework to produce a particular manifestation observed in say, a video recording)? Or is it enough to simply acknowledge the fact that data form an inherent ingredient of the work? A particularly important scenario is when an artwork collects data from user interactions as it runs, each user's interactions feeding into future experiences and adding to the overall artwork. When user influence is crucial not only to their individual experience but is captured and accumulates as an inherent part of the work, questions are raised about not only the 'richest' version of the work (e.g. is the last

[2] System 1.6, http://www.boredomresearch.net/system16.html: Presentation available online at http://vimeo.com/31447537 (accessed 16/11/2011).

enactment any more valid than all those that came before it as it benefits from the accumulated interaction data of previous instantiations) but also of authorship and ownership.

One final issue of how to define and document the essence of interactive works is the relationship between single works and the whole body of work produced by a particular artist, group, or institution. The importance of communicating and curating an ongoing artistic practice is much wider than simply considering interactivity, however to remain focussed on this particular aspect, interactive behaviours can evolve and be learned over one or multiple instantiations, changing the user trajectories both within one artwork and over several pieces by the same creator. Spect-actors integrating knowledge of specific control mechanisms to achieve particular interactions can be clearly observed in computer games and their sequels but from the perspective of the user can be hard to identify – in fact these learned behaviours can seem so natural to users with previous experience that they are baffled when new users demonstrate a lack of interaction knowledge. Given that creators of interactive art are, almost by definition, 'expert' users of their own interactive frameworks, there could be a risk that over-assumption of the mechanics of interaction in their audiences leads to unintended user trajectories, which may well occlude the intended artistic experience. Whilst the dramaturgy of the experience is a core concern for most software artists, not all are, or wish to be, expert interaction designers in terms of specific input/output mechanisms. One danger of removing an individual work from its context in place of the artist's body of work is a failure to acknowledge that this act could inherently change the modes of interaction an audience has with the work.

So, capturing interaction is a task which requires high levels of skill and understanding in both the artistic and curatorial domains in order to document both intent and manifestation of a work, avoid misrepresentation, reflect variability and adaptation over time, and acknowledge variation in human and machine behaviours. The essence of the interactive work may exist simultaneously in multiple layers of reality: a live gallery space, a virtual space, and a networked or conceptual environment[3]. These challenges lead to an incredible burden of documentation and uncertainty about who (if anyone) has the responsibility for ensuring the integrity of interaction is preserved.

Strategies for approaching documentation

Research into digital representations of various types of live artworks has shown that academic researchers value documentation about the process of creating artworks as highly as documentation of the artwork itself (Abbott & Beer, 2006, pp. 31-32). Both performance and interactive art never reach a state of completion, both are open-ended creative endeavours, experienced uniquely, and continually being re-formed as part of an ongoing creative process. The decisions of the creators in setting up these works are as critical to inform future understanding as are the decisions of the participants who shape the work on each instantiation. Museums and galleries have understandably struggled with the curatorial strategies necessary to create collections of media or interactive artworks at both a conceptual and a practical level (Grau, 2003). Therefore, the preservation of these art forms has been neglected until relatively recently, and even if

[3] For example Day of the Figurines and other work by Blast Theory (1991 – present) which blurs the line between performance, interactive art and gaming, existing simultaneously in gallery spaces, outdoors, and on mobile devices and the network (http://www.blasttheory.co.uk).

communities are actively embracing the conceptual challenges, there are still financial and organisational issues to overcome.

Simply put, it is impossible to capture every aspect of an interactive work. This means that creative and interpretative choices are a necessity in order to appraise the artwork and define which of its many facets are the most important, or the most representative, and can be used to give future audiences an accurate sense of the work, yet working within the confines of the time, money and expertise available for documentation and curation. This process of realistic appraisal is one that demands a deep understanding of the work, and is arguably best performed by the creating artist, although it is noted that the perspective of someone without close ties to the work can be exceptionally useful in helping to define how best to capture particular elements. Appraisal is itself a time-consuming task, therefore a useful strategy for managing documentation is to define the drivers for documentation, and choose on which to focus curation efforts. Some common drivers and the questions that surround them are outlined below.

- **Preserving the essence of the work.** It is taken as a given that a major driver is to preserve the integrity of the artwork over time. Issues here include how the artist wishes the work to be preserved and what is the most 'accurate' way it can be captured (which may sometimes conflict), which (if any) stage is the most important (e.g. process of creation, live enactment, subsequent interpretation), behaviours and aesthetics, context including place and significance in the artist's wider practice and society in general. Recording one instantiation of interaction could be critical, as could suggesting how the work 'might have been'.
- **Establishing rights and permissions for re-use and curation.** Clear statements of intent about if and how the artist wishes the work to be re-used in the future, and what rights a curator may have to make changes in order to preserve the work. Once ingested into any sort of collection, the creation of preservation documentation for long-term curation is also a driver.
- **Enabling reconstruction or adaptation.** This could apply to near or far future enactments, or instructions for installing the artwork in another physical or virtual space, or by another artist. What are the crucial/desired/irrelevant elements of the work and what information must be recorded to facilitate reconstructions? The desire or need to collaborate with other artists or technologists is a major driver here (for example, providing clear comments in software code is necessary for other people to understand or adapt it).
- **Extending the reach of the work.** Good documentation that clearly communicates the essence of an interactive work can be used as a research tool, even if the work is itself not re-enacted. This driver encourages the production of high quality documentation that would significantly help a curator. It can even be seen as useful to introduce new creative elements into representation that are a 'surrogate' for the type of interaction experienced in the work, although artists must be aware of the limitations of documentation (e.g. the impossibility of including a frozen pea: (Gray, 2008, p. 414)).
- **Increasing reputation and building a portfolio.** A major driver is for artists to have a collection of past work on which to draw in ongoing practice but also to demonstrate their particular skills and artistic concerns. Interactive and other live artworks pose a particular challenge as they are only represented by their documentation which can be as resource intensive as the initial enactment.

- **Facilitating further work.** Attracting funding for further work is another major driver for interactive artists and relies not only on presenting a portfolio seen to be valuable by the funders, but potentially on documentation which helps to validate previous work, such as project reports and budgets. In addition, reusability of elements of the work (e.g. a section of source code) can be of particular importance to save the artist time in the future.

As can be clearly seen from the examples above, adequate documentation must be an ongoing process, throughout all stages of the creation, instantiation, interpretation, and even curation of an interactive work. Documentation is not a task that can be left until the 'completion' of a work or installation. Commenting code is an ongoing task, not something that is easy or useful to undertake several months later, and retroactive documentation is in many cases simply impossible; if preparations are not made in advance to capture, for example, users' behaviours and reactions when interacting, this information is gone forever. Therefore, a useful strategy is to give thought to not only the most important drivers for documentation well ahead of time, but to plan the timeline of creative documentation decisions: when will particular elements be recorded, collected, or reflected on; who can/will take on the task; who will be responsible for storing (and possibly adding metadata to) the documents; are there any skill gaps for desired evidence collection; how will each documentation decision relate to the overall representation of the work and its context?

Another critical element of documentation is to increase the value of representations by striving for **transparency** in the creative decision-making related to appraisal and ongoing documentation processes already mentioned. Returning to the example of System 1.6, the creators noted that without contextual information, a current audience has no way of knowing that the speed of the sprites' movement is not actually what was intended. A curator could therefore choose to encode a speed limiter to preserve the integrity of the aesthetics of this work, however it is crucial to document this change as a curatorial process; to acknowledge that some of the work's ingredients had been altered, and how. In the same way that a file format migration would be recorded as part of digital preservation, transparency of more subjective curatorial choices is not only necessary to demonstrate or validate some level of archival authenticity for curated works, it also helps to illuminate the curation process which can only be valuable in bring different communities of expertise to a shared understanding.

In a situation where there is an almost infinite amount of information that could be collected, the strategies above will help artists and curators to analyse and prioritise those aspects which will be most meaningful in the preservation of interactive art. As our understanding of the critical issues in this domain grows, so does the opportunity to create higher quality representations with greater long-term value. Nevertheless the issue remains that documentation of interaction is a considerable drain on the resources of artists and curators alike. The first step therefore should always be to investigate ways to **share the burden** and to maximise use of existing work, resources, services, methodologies, and expertise in this field.

Researchers into interaction design have identified a notable gap in the techniques, tools, and expertise to assist documenters in capturing and preserving interactive works (Benford *et al.*, 2009, p. 717). However, recently developed tools and techniques are opening up those areas which have been neglected by a 'traditional' understanding of archiving works and addressing notions such as the documentation of process; collaborative, shared, or networked artworks; and multiple intents, interpretation and user

experiences. For example, the Media Art Notation System offers a conceptual model similar to that of a musical score, that is, a non-proscriptive, structured set of information about works, which explicitly allows for multiple subjective interpretations (Rinehart, 2007).

Furthermore, the development of holistic, high-level curation strategies in recent years, such as the Digital Curation Centre's Curation Lifecycle Model (Higgins, 2008), offer a structured approach which is more appropriate to open-ended works such as performance and interactive artworks. The explicit acknowledgement of an ongoing cycle of curation which includes elements of transformation[4] is particularly useful for addressing the challenges of work in this domain.

Several national initiatives in the UK offer resources designed to reduce the burden of documentation and curation for practising artists and much of the information provided could be extremely useful for planning and achieving efficient and high quality documentation processes. The resources available range from the highly technical (e.g. file formats and standards, registries of representation information) to general best-practice guides, case studies, and briefing papers aimed at non-experts. There are also a range of templates for planning documentation and preservation (e.g. data management plans, usage rights declarations).[5]

Finally, the DOCAM Research Alliance has a series of research outputs and practical resources aimed specifically at the documentation and conservation of media arts heritage. They span cataloguing, conservation, the history of relevant technologies, and a complete documentation model based on the whole lifecycle of the artwork. These resources are an excellent starting point for planning the best possible ways in which to preserve interactive works.

Conclusion

Documentation of interaction, whether 'real' or virtual can be difficult, time-consuming, and expensive, often leading to the production of data that is just as complex as the artwork itself. It is crucial to have a clear and realistic strategy for producing appropriate, accurate, and evocative representations of interactions within artworks and their relationship to the aesthetics, form, function, and context of the overall work. Professional artists and curators have different skills and knowledge and must work together on this challenging task with a clear understanding of both the reasons for producing documentation, and the creative decision-making that underlies the entire process. Creating an interactive artwork is an open-ended activity and includes documentation strategies within it. To successfully open up the possibilities for future interpretation, re-use, and preservation of interactive works, artists and curators alike should be familiar with both the intellectual and practical challenges of documentation, as well as the existing methodologies and resources that can be used to produce the best possible outcome.

[4] Cf. Digital Curation Lifecycle Model: http://www.dcc.ac.uk/resources/curation-lifecycle-model

[5] Examples of freely available resources can be found at http://www.dcc.ac.uk/resources; http://www.jisc.ac.uk/whatwedo/services.aspx; http://www.dpconline.org/; and of course http://www.pocos.org/

References

Abbott, D., & Beer, E. (2006). Getting to Know Our Audience: Ahds Performing Arts Scoping Study. Glasgow, UK: AHDS Performing Arts.

Abbott, D., Jones, S., & Ross, S. (2008). Theoretical Discussions on Digital Representations of Performance. In N. Leclercq, L. Rossion & A. Jones (Eds.), Capturing the Essence of Performance: The Challenges of Intangible Heritage (pp. 81-88). Oxford: P.I.E Peter Lang.

Benford, S., Giannachi, G., Koleva, B., & Rodden, T. (2009). From Interaction to Trajectories: Designing Coherent Journeys through User Experiences. Paper presented at the CHI 2009: Conference on Human factors in Computing Systems, Boston, Massachussets.

Benford, S., Reeves, S., O'Malley, C., & Fraser, M. (2005). Designing the Spectator Experience. Paper presented at the CHI 2005: Conference on Human factors in Computing Systems, Portland, Oregon.

Brook, P. (1968). The Empty Space. London: MacGibbon & Kee.

Grau, O. (2003). Virtual Art : From Illusion to Immersion. Cambridge, Mass.: MIT Press.

Gray, C. (2008). Can Documentation Re-Create and Enhance Theatre? In N. Leclercq, L. Rossion & A. Jones (Eds.), Capturing the Essence of Performance: The Challenges of Intangible Heritage (pp. 409-419). Oxford: P.I.E Peter Lang.

Hagebölling, H. (2004). Introduction, Elements of a History of Interactive Dramaturgy. In H. Hagebölling (Ed.), Interactive Dramaturgies: New Approaches in Multimedia Content and Design (pp. 1-16). Berlin: Springer.

Higgins, S. (2008). The DCC Curation Lifecycle Model. IJDC International Journal of Digital Curation, 3(1), 134-140.

Kulik, A. (2009). Building on Realism and Magic for Designing 3d Interaction Techniques. IEEE Comput Graphics Appl IEEE Computer Graphics and Applications, 29(6), 22-33.

Laurel, B. (1993). Computers as Theatre. Reading, Mass: Addison-Wesley Longman.

Rinehart, R. (2007). The Media Art Notation System: Documenting and Preserving Digital/Media Art. Leonardo, 40(2), 181-187.

Smith, P., & Isley, V. (2011). Best before… Software Artworks May Be Seen after This Date; However Their Quality May Be Affected by Improper Storage. Software Art [Presentation]. Glasgow: Preservation Of Complex Objects Symposia (POCOS).

Utvich, M. (2004). The Circular Page: Designing a Theatre of Choice. In H. Hagebölling (Ed.), Interactive Dramaturgies: New Approaches in Multimedia Content and Design (pp. 221-229). Berlin: Springer.

Bridging the Gap in Digital Art Preservation: Interdisciplinary Reflections on Authenticity, Longevity and Potential Collaborations

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Digital casualties: challenges for digital art preservation

Born digital art is fundamentally art produced and mediated by a computer. It is an art form within the more general "media art" category (Paul, 2008a; Paul, 2008b; Depocas *et al.*, 2003; Grau, 2007; Lieser, 2010) and includes software art, computer-mediated installations, Internet art and other heterogeneous art types.

The boundaries of digital art are particularly fluid, as it merges art, science and technology to a great extent. The technological landscape in which digital art is created and used challenges its long term accessibility, the potentiality of its integrity, and the likelihood that it will retain authenticity over time. Digital objects – including digital artworks – are fragile and susceptible to technological change. We must act to keep digital art alive, but there are practical problems associated with its preservation, documentation, access, function, context and meaning. Preservation risks for digital art are real: they are technological but also social, organizational and cultural[1].

Digital and media artworks have challenged "traditional museological approaches to documentation and preservation because of their ephemeral, documentary, technical, and multi-part nature" (Rinehart, 2007b, p. 181). The technological environment in which digital art lives is constantly changing, and this fast change makes it very difficult to preserve this kind of artwork. All art changes. And these changes can occur at art object level and at context level. In most circumstances this change is very slow, but in digital art this isn't the case anymore because it is happening so quickly, due to the pace of technological development.

Surely the increased pace of technological development has more implications than just things happening faster. Digital art, in particular, questions many of the most fundamental assumptions of the art world: What is it a work of art in the digital age? What should be retained for the future? Which aspects of a given work can be changed and which must remain fixed for the work to retain the artist's intent? How do museums collect and preserve? Is a digital work as fragile as its weakest components? What is ownership? What is the context of digital art? What is a viewer[2]? It is not feasible for the arts community to preserve over the centuries working original equipment and software. And

[1] See for example the work done in the DRAMBORA (Digital Repository Audit Method Based On Risk Assessment), created and developed by DigitalPreservationEurope and the UK Digital Curation Centre, see http:/www.repositoryaudit.eu/, accessed 06/08/2012. Among other benefits, using this tool allows to build a detailed catalogue of prioritized pertinent risks, categorized according to type and inter-risk relationships, that includes not only technical but also for example organizational and legal risks, in relation to the organization's mission, objectives, activities and assets. See (Innocenti *et al.*, 2008).

[2] The artist creates the context, the platform, the set of rules by which the viewer participates and often produces. But in an increasing number of cases in media art, the viewer is not only a human but also an artificial agent, a software interpreting the artist work.

industry has no incentive to reproduce old parts or to make current parts backwards compatible. Furthermore, as Richard Rinehart noted, due to lack of formal documentation methods and the goal to bypass traditional art world's values and practices, media art works are "becoming victims to their own volatile intent" (Rinehart, 2007b, p. 181). Museums have long played a critical role in the creation and transmission of knowledge, culture and identity (Bennett, 2009; Knell *et al.*, 2007). As they undergo a metamorphosis from the physical to the virtual, museums continue to serve this custodial role, although their nature and reach might be very different in the future. In particular, as museums invest in collecting digital works, they come to recognize that these works are fragile and may require substantial continued investment in finance and effort to keep them accessible over time.

Long term accessibility of digital art: previous work

Digital art may seem less physical than traditional art. But as novelist Bruce Sterling noted, "very little materiality, is very, very far from no materiality at all." (Stirling, 2003, p. 15) The bitstream might be composed by numbers, but the device – the computer – has similar conservation problems as a painting (e.g. humidity, heat, physical damage), plus a whole set of new ones.

Digital preservation is not only about keeping the bits that we use to represent information, but to keep these bits alive, as an ongoing activity to ensure recurring value and performance of digital objects, including digital artworks. As Seamus Ross clarified, digital preservation is about "maintaining the semantic meaning of the digital object and its content, about maintaining its provenance and authenticity, about retaining its interrelatedness, and about securing information about the context of its creation and use" (Ross, 2007, p. 2). Conservation and restoration are relevant, however they are part of a larger group of activities to ensure longevity for digital objects: collection and repository management, selection and appraisal, destruction, risk management, preserving the context, interpretation and functionality of objects, ensuring a collection's cohesion and interoperability, enhancement, updating and annotating, scalability and automation; storage technologies and methods.

In the last decades, much work has been done towards establishing the long-term accessibility of electronic, media and digital art, as well as documenting media and digital art in order to keep it accessible in the future. Some of the key projects and initiatives in this area were started already in the 1970s (for example, the Electronic Art Intermix [EAI] and the Netherlands Media Art Institute [NIMk], Montevideo/Time Based Arts) and further initiatives developed through the following decades, including V2, Matters in Media Art, Forging the Future and DOCAM[3].

[3] For more information on the Electronic Art Intermix (EAI) see: http://www.eai.org/index.htm, accessed 08.06.2012; for the Netherlands Media Art Institute NIMk, Montevideo/Time Based Arts, see: http://www.nimk.nl/, accessed 06/08/2012. Further projects and initiatives developed over the last decades are:

- Independent Media Arts Preservation (IMAP), since 1999, see: http://www.imappreserve.org/, accessed 06/09/2012.
- International Network for Conservation of Contemporary Art (INCCA), since 1999, see: http://www.incca.org/, accessed 06/09/2012.
- Variable Media Network, 2000-2004, see: http://www.variablemedia.net/, accessed 06/09/2012.
- AktiveArchive Project, 2001-2009, see: shttp://www.aktivearchive.ch/content/projekte.php, accessed 06/09/2012.

These projects and initiatives have contributed to raising awareness on some of the challenges of digital art preservation, examine media and digital art works, explore some specific documentation aspects, and initiate collaborations with other institutions. Nevertheless, much of this work has been survey-like and not particularly well-founded from either a theoretical or methodological perspective. So far, the theoretical aspects of the problem of digital art preservation and curation have been examined without much grounding particularly in experimentation, and not responding to the theoretical and methodological dilemmas posed by digital art (e.g. transience, emergence, and lack of fixity). Also the long term preservation of documentation for digital art has not yet been systematically addressed. Documentation for digital art is at risk as much as digital artworks themselves, and needs sustainable business and organisational models to be preserved in the long term.

It is evident that digital art is a new phenomenon that requires a new suite of methodologies.

An interdisciplinary methodological approach to the preservation of digital art

The goal of the research project Preserving Computer-Generated Imagery: Art Theory, Methods and Experimental Applications[4] that I am conducting at the University of Glasgow is to contribute to laying the foundations for a preservation framework of digital art and identifying interdisciplinary synergies with areas such as digital preservation, philosophy of art, museology, archival science and information management. Digital art is after all data designed to be constructed (represented, viewed, experienced) in particular ways, whose theoretical implications need consideration. The methodology that I have chosen to take is bottom up, to try to understand how digital art works. That is: I am starting with the works, the conservators and the creators. So I have decided to adopt a two-step approach, described below: onsite visits to major international collectors of

- Archiving the Avant-Garde: Documenting and Preserving Variable Media Art, 2002-2010, see: http://www.bampfa.berkeley.edu/about/avantgarde, accessed 06/09/2012.
- 404 Object Not Found. What remains of Media Art?, 2003. Sadly this project is no longer available online. A project description is at http://nimk.nl/eng/404-object-not-found-what-remains-of-media-art.
- V2_ Capturing Unstable Media, 2003, see: http://capturing.projects.v2.nl/, accessed 06/11/2012.
- Matters in Media Art: collaborating towards the care of time-based media, since 2003; see: http://www.tate.org.uk/about/projects/matters-media-art, accessed 06/11/2012.
- packed.be, since 2003; see: http://www.packed.be/, accessed 06/11/2012.
- PANIC (Preservation web services Architecture for New media and Interactive Collections), since 2003; this project website is being preserved by the National Library of Australia at http://pandora.nla.gov.au/tep/49720, accessed 06/11/2012.
- Inside Installation Project, 2004-2007, see: http://www.inside-installations.org/home/index.php, accessed 06/11/2012.
- 40yearsvideoart.de, 2004-2006, see: http://www.40jahrevideokunst.de/main.php?p=3, accessed 06/11/2012.
- Ludwig Boltzmann Institut - Medien.Kunst.Forschung, 2005-2009, see: http://media.lbg.ac.at/de/index.php, accessed 06/11/2012.
- Forging the Future: New Tools for Variable Media Preservation, 2007-2008, see: http://forging-the-future.net/, accessed 06/11/2012.
- DOCAM - Documentation and Conservation of the Media Arts Heritage project, 2005-2009, see: http://www.docam.ca/, accessed 06/11/2012.

[4] Some aspects of my research have been published in (Innocenti, 2010).

digital art and in-depth interviews with their staff; and experimentation with testbeds to assess preservation methods and processes.

I am using a mixed method of humanistic, social science and engineering approaches, described below.

The humanistic element of it is the art history element, and the reflection on what is a work of art in the digital age and what is the context of digital art. I am presenting some 'Reflections on authenticity and longevity for digital art' in the following section of this paper, ideas which have been further shaped by my social science approach mentioned below.

Social science approach

From a social science perspective I have visited and talked with some of the most important collectors of digital art conducting a whole series of interviews, which have provided me a window on the practices of different organisations which are working with digital art. I have borrowed methods from anthropology and grounded theory. Ethnography has become a common feature in social studies of scientific knowledge and technology, in particular thanks to Stephen Woolgar (Woolgar, 1996; Cooper *et al.*, 1995). In my ethnographic process of observation of digital art, I am looking at key digital art organizations and how they are collecting, curating, preserving, displaying, and financing digital art. I am conducting onsite in-depth interviews, visits and observations because what I am told is sometimes at variance with what is being done. The organizations that I am targeting and selecting for my case studies are major international collectors of digital artworks and digital art documentation. I visited ZKM | Media Museum at the ZKM | Center for Art and Media Karlsruhe (Germany), Ars Electronica Centre – AEC (Linz, Austria), The Hirshhorn Museum and Sculpture Garden (Washington D.C., USA), Smithsonian American Art Museum and Lunder Conservation Center (Washington D.C., USA), Museum of Modern Art in San Francisco – SFMOMA (San Francisco, USA), Berkeley Art Museum – BAM (Berkeley, USA), Museum of Modern Art – MOMA (New York, USA), Whitney Museum of American Art (New York, USA), and the Netherlands Media Art Institute – NIMk (Amsterdam, the Netherlands).

The complexity of maintaining the object longevity and the myriad of change that can occur over time means that we need to talk with organizations that have decades of experiences to understand what needs to be done in this area. Interviews with stakeholders of digital art preservation (museum directors, conservators, curators, registrars, technicians) are a new approach in this area. I have also conducted interviews and observations with selected digital artists (John Gerrard, Studio Azzurro, Maurice Benayoun) for an additional analysis of relevant aspects of preservation for digital artworks.

Engineering approach

Preservation for computer-based art is more than just a question of trying to understand about the problem. We also need to take a little bit of time to see what might be possible because – as I have concluded after my first visit at ZKM that preservation and curation of digital art is as much an art historical problem, as it is an engineering problem. One of the fundamental challenges in the preservation of digital art is that the work of the conservators tends to be ad hoc. It is also based upon responsiveness to unique situations

and not constructed on a body of theory and practice, as other aspects of art management and restoration tend to be. This should hardly surprise us, thought, as digital art is a new phenomenon. So in the second phase of my investigation I decided to design engineering experiments to advance the understanding of the processes and methods by which digital art can be preserved and handled. For example to preserve digital objects, we need to be able to extract essential characteristics – the significant properties (see for example Guttenbrunner *et al.*, 2010; Hedstrom & Lee, 2002) – of the digital object from a file, to decide whether approaches such as migration and emulation will work for maintaining digital objects in accessible form. This is a new approach to research in this area.

Reflections on authenticity and longevity of digital art

Two aspects emerged from the first phase of my investigation strike me as key for digital art preservation: the intrinsic performing nature of digital art, and the dynamic nature of digital art authenticity.

Digital art as a process of components interactions

The ability to establish authenticity in a digital object is crucial for its preservation (Ross, 2002). Even if the concept of authenticity is highly nuanced in the digital age, it is still a starting point for discussion about digital art. But to talk about authenticity we need to look at how digital art is created and rendered. For example, the image of the work *Bubbles* (2001) by Muench and Furukawa (Fig. 1), is a process of interaction of many components: for this example particularly, the file in which the data matrix representing the image is stored, and the software capable of interpreting and rendering this data form. If we were to explore this example in full, we would also need to discuss the hardware, the data projector, the screen, and the relationships (including intended effects) that all this has with the viewer.

Figure 1: Muench and Furukawa, *Bubbles*, 2001, ZKM | Media Museum. © ZKM | Center for Art and Media Karlsruhe

Digital art as performance

This interaction of components leads me to think that all digital art is a performance, and more than a performance between the viewer and the object.

In this particular instance, the performance that I am actually talking about is the performance of the work. Because a digital artwork consists of a set of code, and for the artwork to become, it must be performed. Before the viewer interacts with the digital artwork, this process of becoming has to occur. For example in the case of John Gerrard's 3D real time work Grow Finish Unit (near Elkhart, Kansas) (2008), the algorithm developed by Gerrard needs to be performed in order for the work itself – the real time 3D – to come to life.

This problem isn't actually unique to digital art. For example, within the AktiveArchive project, Johanna Phillips and Johannes Gfeller wrote interesting reflections about reconstruction and well-informed re-performances of video art (Phillips, 2009; Gfeller, 2009)[5]. But in the field of digital art, it is nearly another construct. Some very groundbreaking work in the documentation of performances has been done by Richard Rinehart, former digital media artist and director of the UC Berkeley Art Museum/Pacific Film Archive. Rinehart produced a promising theoretical approach based on a formal notation system for digital and media art creation, documentation and preservation: the Media Art Notation System (MANS) (Rinehart, 2007b). He compared media art to the performative arts, because media art works do not exist in a stable medium, and are inherently variable and computational. Their preservation is thus an interpretive act. Given the similar variability of music and media arts, Rinehart considers as appropriate a mechanism like a musical score for binding the integrity of media art works apart from specific instruments.

Instantiations, authenticities and documentation in digital art

Considering digital art as performance leads to some interesting reflections about its instantiations.

As Seamus Ross observed, the "first renderings of digital objects might best be referred to as an initial 'representation or instantiation'. The problem is: how can we record the functionality and behaviour as well as the content of that Initial Instantiation (II) so that we can validate subsequent instantiations? Where Subsequent Instantiations (SI) share precision of resemblance in content, functionality, and behaviour with the initial instantiations, the 'SIs' can be said to have the same authenticity and integrity as the 'IIs' (Ross, 2006). This notion of precision of resemblance is intended to reflect the fact that initial instantiations of digital objects and subsequent ones will not be precisely the same, but will have a degree of sameness. This degree of sameness will vary overtime – in fact in the case of digital objects it is likely to decline as the distance between the initial instantiation and each subsequent one becomes greater, although this degree of variation may be mitigated by such circumstances as for example the frequency at which the digital object is instantiated. So each time a digital work of art is instantiated, it has a greater or lesser precision of resemblance to the initial instantiation, which the artist created. The subsequent instantiations represent with greater or lesser degrees of accuracy the intentionality of the artist. Whether they have greater or lesser degrees of authenticity is a separate but fundamentally important question and need to be considered in the context

[5] Some useful reflections are also published in Hermens & Fiske (2001).

of, for example, the authenticity of performances. The UNESCO Guidelines for the Preservation of Digital Heritage mentions the question of assessing an acceptable level of variance of such instantiations (National Library of Australia & UNESCO, 2003, § 16.7) . This was also more recently highlighted by Richard Rinehart, in relation to the ecological balance of changes in the technological environment of digital art[6].

The intrinsic performing nature of digital artworks makes them allographic rather than autographic works, along the distinction described by Nelson Goodman (Goodman, 1969)[7]. So I would like to draw a parallel between the instantiation of the code in a digital work, and the instantiation of the notation in a music performance, as described by John Butt (2002) and Dennis Dutton (2003).

We often assume that music notation is a rigid set of instructions. In reality, sometimes notation is the result of performance, sometimes it is a reminder, and sometimes it is just an example. There is no single process from notation to performance. The notation is going in all directions, with a complex relationship between sender and receiver. In his seminal book Playing with history: the historical approach to musical performance (Butt, 2003), John Butt has questioned whether "authenticity" is still an appropriate term for music performance given that, in performance terms, it tends to condemn its negative to a sort of fake status. In music, partly through Butt's effort, we now tend to use the term "historically informed performance". In his reflection on nominal authenticity in the arts, Dutton writes, "the best attitude towards authenticity in music performance is that in which careful attention is paid to the historic conventions and limitations of a composer's age, but where one also tries to determine the artistic potential of a musical work, including implicit meanings that go beyond the understanding that the composer's age might have derived from it." (Dutton, 2003)

The dynamic notion of authenticity of digital art might seem to be in contrast with the notion of material authenticity that has been constructed for historical artworks. If we look at authenticity in object conservation in museums, authenticity is a term associated with the original material components and process in an object, and its authorship or intention. For example, in his critique of traditional conservation ethics, Jonathan Kemp describes "authenticity in the sense of 'original material', traditionally one aspect of an object charged with the assignation of a 'truth value' that legitimizes some aesthetic experiences." (Kemp, 2009, pp. 60-61) However these conservation principles are socially constructed processes mediated by technology-based practices, whereas the object keeps changing: it deteriorates, its context might change, and the way that it is conserved and re-displayed will change. The role of conservators and of museums also changes over time. Therefore the conservators are caught between reconciling fidelity to the original artist intention, and fidelity to the passage of time. Joseph Grigely also argued that any work of art is subject to a "continuous and discontinuous transience" (Grigely, 1995, p. 1), that is integral to its authenticity. This means that any work of art – I shall

[6] Perla Innocenti, Interview on curation and digital preservation of time-based/media art of with Richard Rinehart, Berkeley Art Museum (BAM), 25 March 2010). In Rinehart's recent presentation , "Artworks as Variability Machines" at the Second Symposium on the Preservation of Complex Objects: Software Art, JISC-funded POCOS Project, 11 October 2011, Glasgow, this concept was further discussed (see also Rick Rinehart and Jon Ippolito's forthcoming book, Re-collection: New Media and Social Memory, MIT Press, 2013 (http://re-collection.net/).

[7] In the chapter on "Art and Authenticity", Goodman distinguishes between two basic kinds of artworks, based on the relationships between and artwork and its copies. In the chapter "The Unfakable", Goodman mentions that in autographic works, such as artworks, even the most accurate copy is not considered authentic, whereas in allographic works such as musical performances there are many possible alternative versions of a composition, all of which might be considered authentic.

add including digital art – is not fixed in a single point in time, but it is rather in a "continuous state of becoming", as Heather MacNeil and Bonnie Mak elegantly pointed out (MacNeil & Mak, 2007, p. 33). Like in Penelope's tale, conservators are actively constructing and reconstructing the authenticity of a work based on their understanding of its nature and the current conventions and assumptions for conserving it.

These reflections on instantiations and authenticity led my attention to the concept of authenticity in electronic records. As Jennifer Trant noted, "archives have been challenged to manage electronic records as evidence for several decades […]" (Trant, 2009, p. 373). Like art conservators, archivists and record keepers are concerned with issues of fidelity. The trustworthiness of a record rests primarily on its fidelity to the original event, from which the record arises. The concept of provenance – a well-documented chain of custody – is thus a fundamental archival principle, which helps establishing authenticity[8].

This has parallels with my reflections on instantiations of digital artworks. If we look at computer-based art from the point of view of performance and archival authenticity, what is then really important is a trustworthy chain of documentary evidence about the work genuine origins, custody, and ownership in the museum collection. Authenticity is not an original condition, but it is rather a dynamic process. Digital artworks are pushing the boundaries of traditional conservation practices and the notion of historicity. For example, let's look at the ongoing preservation strategy devised within the Digital Art Conservation project[9] for the interactive media art work The Legible City, 1989-1991 (Fig. 2) in the ZKM | Media Museum. This strategy could be seen as the equivalent of rewriting an older music score to adapt it to a modern or different instrument. On one hand, this iconic interactive installation is based on proprietary, work-specific software; on the other, it uses obsolete hardware and custom-made components. Such combination makes the preservation of Legible City a costly and risky business, both for the price of maintaining its Indigo 2 computer (no longer produced by Silicon Graphics) and because of the potential weak point represented by its specially-built analog-digital transformer. Conservators at ZKM examined, documented and created a fully-functional replica of this transformer (the interactivity intended as part of the installation was also recorded), and software porting to another operating system is currently being evaluated by the ZKM as a more sustainable long-term preservation solution for the Indigo 2 computer .

Some conservators and curators might argue that the replacement of the historical software and transformer challenges the historicity and originality of the artwork. However, digital art collectors need to come to terms with the fact that it will not be possible to guarantee forever original working equipment: in order to be kept alive, digital artworks will need to be adapted to a new technology[10]. This artwork at ZKM is in the

[8] In archives authenticity is "the quality of being genuine, not counterfeit, and free from tampering, and is typically inferred from internal and external evidence, including its physical characteristics, structure, content, and context." See: The Society of American Archivists (SAA), A Glossary of Archival and Records Teminology, available online at: http://www.archivists.org/glossary/term_details.asp?DefinitionKey=9, accessed 06/11/2012. In terms of evidence, "provenance is a fundamental principle of archives", defined as "information regarding the origins, custody, and ownership of an item or collection." See: The Society of American Archivists (SAA), A Glossary of Archival and Records Terminology, available online at: http://www.archivists.org/glossary/term_details.asp?DefinitionKey=196, accessed 06/11/2012.

[9] Digital Art Conservation, 2011, ZKM | *Center for Art and Media Case Study: Jeffrey Shaw, The Legible City*. *http:/www02.zkm.de/digitalartconservation/index.php/en/exhibitions/zkm-exhibition/nnnnnjeffrey-shaw.html*, accessed 06/11/2012.

[10] Perla Innocenti, Interview on digital preservation on media art of with Dr. Bernhard Serexhe, ZKM | Media Museum, Karlsruhe, 12 August 2008.

state of becoming. This idea of becoming is clearly referenced in the work of Heather McNeil Bonnie and Mak about constructions of authenticity, and this goes back to the notion that digital art becomes, which I mentioned earlier. Digital works are in a state of evolution.

Figure 2: Jeffrey Shaw, *The Legible City*, 1989-1991, ZKM | Media Museum. © ZKM | Center for Art and Media Karlsruhe

Cultural institutions and cross-domain collaborations in digital preservation

Digital preservation is characterized by a wide range of activities to ensure longevity for digital objects, as mentioned at the beginning of this paper. It is thus an interdisciplinary area, in which diverse disciplines – for example archival science, library science, information management, computer forensics – are converging to support organisations in making their digital assets available to future users. The results of my research on digital art preservation suggest the potential benefits of cross-domain digital preservation partnerships and collaborations between cultural institutions.

The term 'cultural institution' can be characterized by a number of specific features: the presence of a collection, offered to users within the frame of a systematic, continuous, organized knowledge structure and encompassed by scholarship, information and thought. Cultural institutions typically address public knowledge and memory, in a culture of inquiry and learning, and with interdisciplinary dynamic connections. They also deal with the need to create a coherent narrative, a story of who we are and what our cultural, historical and social contexts are. In modern Western society, cultural institutions include but are not limited to museums, libraries, archives (sometimes jointly defined as LAMs – Libraries Archives and Museums; see Zorich *et al.* (2008)), galleries, and other heritage and cultural organizations.

Their histories are often intertwined, although their interrelations have not always led to a consolidated path of collaboration. For example, although often originating as unified 'universal museums', museums and libraries have developed separate institutional contexts and distinct cultures. Jennifer Trant noted how philosophies and policies of museums, archives and libraries now reflect their different approach to interpreting, collecting, preserving and providing access to objects in their care (Trant, 2009). Liz Bishoff remarked that "libraries believe in resource sharing, are committed to freely available information, value the preservation of collections, and focus on access to information. Museums believe in preservation of collections, often create their identity based on these collections, are committed to community education, and frequently operate in a strongly competitive environment" (Bishoff, 2004). In the last century policy-makers have attempted to group and bridge these communities of practices through "their similar role as part of the informal educational structures supported by the public, and their common governance" (Trant, 2009, p. 369).

Such commonalities are increasingly important to the sustainability of museums, libraries and public cultural institutions in a globalized world. The International Federation of Libraries Association (IFLA) remarked that museums and libraries are often natural partners for collaboration and cooperation (Yarrow *et al.* 2008). One of the IFLA groups, Libraries, Archives, Museums, Monuments & Sites (LAMMS) , unites the five international organisations for cultural heritage, IFLA (libraries), ICA (archives), ICOM (museums), ICOMOS (monuments and sites) and CCAAA (audiovisual archives), to intensify cooperation in areas of common interest. In this context, a study in the United States observed that "collaboration may enable [...] museums and libraries to strengthen their public standing, improve their services and programs, and better meet the needs of a larger and more diverse cross–sections of learners" (Institute of Museum and Library Services (U.S.), 2004, p. 9). Archives were often a virtuous third player in museum and library collaborations. For example Rick Reinhart with Tim Hoyer secured a grant application from California Digital Library to the Institute of Museum and Library Services, National Leadership Program for a project integrating museums, libraries and archives access in the Online Archive of California (Rinehart, 2007a; Rinehart, 2003)[11].

Some studies of museum and library collaborations[12] have highlighted the benefits of joining forces and resources in a variety of areas, including but not limited to library activities and programmes related to museum exhibits; travelling museum exhibitions hosted in libraries; links between web-based resources in library and museum websites; library programmes including passes to museums; collaborative digitization and digital library projects enhancing access to resources in both museums and libraries; collaborative initiatives to bring in authors as speakers; museum and library partnerships with other cultural and educational organizations. Partnerships in digital preservation research, practical applications and training would be a natural and mutually benefiting addition to such portfolio of collaborations, as shown by the few but slowly increasing number of partnerships in this area[13].

[11] For further examples see also Timms (2009) and Rodger *et al.* (2011).
[12] See for example: Gibson *et al.* (2007); Zorich *et al.* (2008); Yarrow *et al.* (2008).
[13] See for example the partnerships of libraries, museums and archives (such as the stewardship strategy and three-year action plan for SEMLAC, The North East collections care scheme and the ALM strategy for archive, library and museum collections) mentioned in Walker (2006). For On The North East Collections care scheme see also Hingley (2009). For preservation training initiatives, the EU-funded collaborative DigCurV project (http://www.digcur-education.org/) is addressing the availability of vocational training for digital curators in the library, archive, museum and cultural heritage sectors.

The fruitful convergence between museums and libraries faces a number of challenges with respect to their different mission, culture, organizational and funding structure. The nature of this collaboration can be multifaceted and varied, and the terminology itself is interpreted with diverse meanings, in particular regarding the degree of intensity of the collaboration and its transformational capacity, as noted by Hannah Gibson, Anne Morris and Marigold Cleeve[14] and by Betsy Diamant-Cohen and Dina Sherman[15]. However the numerous opportunities for improving access to collections and leveraging funding seem worth the challenge, also for partnerships in digital preservation.

Conclusions: for a dynamic preservation model of digital art

With this paper, I hope to stimulate discussions about current and future approaches for digital art preservation, and contribute to the interdisciplinary foundations of a scientific framework for digital art preservation.

Authenticity – as MacNeil and Mak clearly pointed out – is a social construct, whose parameters and contents are always changing and under negotiation. Authenticity allows us to author stability in our disciplines. The current fast-paced digital environment defies the traditional structures of stability that have been authored for traditional art. Therefore our approach to digital artworks should be variable and digital object responsive, with a level of variability tolerance to match digital art intrinsic variability and dynamic authenticity, as outlined in this paper. The designated community for whom we are preserving should also be identified, together with the modality of restaging digital works and of preserving the related digital documentation. In conclusion, if conservation for digital art is a moving target, then our scientific methodology should be a moving gun.

Acknowledgments. I am deeply indebted to Prof. Seamus Ross at the Faculty of Information, University of Toronto, for his precious suggestions, guidance and support throughout this research, and more recently to Prof. John Butt at the University of Glasgow, for sharing his knowledge and experience on musical performance. I am also very grateful to all my interviewees for the time and helpful insights that they have shared with me regarding conservation and preservation for digital art.
The aspects related to cross-domain partnerships between cultural institutions are part of an ongoing investigation on networks of museums, libraries and public cultural institutions, which I am leading within the EU-funded project European Museums in an age of migrations (MeLa), funded within the European Union's Seventh Framework Programme (SSH-2010-5.2.2), Grant Agreement n. 266757.

References

Altshuler, B. (2005). Collecting the new: a historical introduction. In B. Altshuler (ed.) *Collecting the new: Museums and contemporary art*. Princeton, N.J: Princeton University Press.

Bennett, T. (2009). The birth of the museum: History, theory, politics (reprint). London: Routledge.

Bishoff, L. (January 01, 2004). The Collaboration Imperative. *Library Journal, 129,* 1, 34-35.

Butt, J. (2002). *Playing with history: The historical approach to musical performance*. Cambridge: Cambridge University Press.

[14] Hannah Gibson, Anne Morris and Marigold Cleeve noted that "'Library-museum collaboration' can be defined as the cooperation between a library and a museum, possibly involving other partners" (Gibson, Morris & Cleeve, 2007, p. 53).

[15] The authors use the term 'collaboration' with the meaning indicated by Betsy Diamant-Cohen and Dina Sherman, as "combining resources to create better programs while reducing expenses" (Diamant-Cohen & Sherman, 2003, p. 105).

Cooper, G., Hine, C., Rachel, J., Woolgar, S. (1995). Ethnography and human-computer interaction. P. J. Thomas (ed). *The social and interactional dimensions of human-computer interfaces* (pp. 11-36). Cambridge: Cambridge University Press.

Depocas, A., Ippolito, J., Jones, C., & Daniel Langlois Foundation for Art, Science and Technology. (2003). *Permanence through change: The variable media approach = La permanence par le changement : l'approache des médias variable*. New York: Guggenheim Museum Publications.

Diamant-Cohen, B., & Sherman, D. (2003). Hand in Hand - Museums and Libraries Working Together. *Public Libraries, 42,* 2, 102.

Dutton, D. (2003). Authenticity in Art. In J. Levinson (ed). *The Oxford handbook of aesthetics*. Oxford: Oxford University Press.

Gfeller, J. (2009). The reference hardware pool of AktiveArchive at Bern University of Arts. A basis for a historically well-informed re-performance of media art. In I. Schubiger (ed.) *Reconstructing Swiss video art from the 1970s and 1980s* (pp. 166-174). Zurich: JRP Ringier.

Gibson, H., Morris, A., & Cleeve, M. (2007). Links between Libraries and Museums: Investigating Museum-Library Collaboration in England and the USA. *Libri, 57,*2, 53-64.

Goodman, N. (1969). *Languages of art: An approach to a history of symbols*. London: Oxford University Press.

Graham, B., & Cook, S. (2010). *Rethinking curating: Art after new media*. Cambridge, Mass: MIT Press.

Grau, O. (2007). *MediaArtHistories*. Cambridge, Mass: MIT Press.

Grigely, J. (1995). *Textualterity: Art, theory and textual criticism*. Ann Arbor: University of Michigan Press.

Guttenbrunner, M., Wieners, J., Rauber, A., and Thaller, M. (2010). Same But Different – Comparing Rendering Environments for Interactive Digital Objects. In M. Ioannides, D. Fellner, A. Georgopoulos and D. G. Hadjimitsis (eds.), *Digital Heritage*. Paper presented at the Third International Conference, EuroMed 2010, Lemessos, Cyprus, November 8–13, 2010.

Hedstrom, M. & Lee, C. A. (2002). Significant properties of digital objects: definitions, applications, implications. In *Proceedings of the DLM-Forum 2002. @ccess and preservation of electronic information: best practices and solutions*, Barcelona, 6–8 May, 2002, European Communities, Luxembourg, 2002, pp. 218-223.

Hermens, E., & Fiske, T. (2001). Art Conservation and Authenticities. Material, Concept, Context. In D. Bearman, & F. Garzotto (Eds). *ICHIM 01: International Cultural Heritage Informatics Meeting : cultural heritage and technologies in the third millennium*. Milan: ICHIM.

Hingley, S. (2009). Preservation: the benefits of partnership working. Paper presented at Doing more with less, Preservation Advisory Centre forum on skills development, 30 November 2009, British Library Conference Centre. Available from, http://www.bl.uk/blpac/pdf/forumpartnerships.pdf

Innocenti, P. (2010). Theories, methods and testbeds for curation and preservation of digital art. Paper presented at IS&T Archiving 2010 Preservation Strategies and Imaging Technologies for Cultural Heritage Institutions and Memory Organisations Conference, 1-4 June 2010, The Hague.

Innocenti, P., McHugh, A., & Ross, S. (2008). Tackling the risk challenge: DRAMBORA Interactive. In P. Cunningham and M. Cunningham (eds.). *Collaboration and the Knowledge Economy: Issues, Applications, Case Studies*. Amsterdam: IOS Press.

Institute of Museum and Library Services (U.S.). (2004). *Charting the landscape, mapping new paths: Museums, libraries, and K-12 learning*. Washington, DC: Institute of Museum and Library Services.

Kemp, J. (2009). Chapter 6: Practical Ethics v2.0. In A. Richmond, & A. Bracker (2009). *Conservation: Principles, Dilemmas and Uncomfortable Truths* (pp. 60-72). Burlington: Elsevier.

Knell, S. J., Macleod, S., & Watson, S. E. R. (2007). *Museum revolutions: How museums change and are changed*. London: Routledge.

Lieser, W. (2010). *Digital art: Neue Wege in der Kunst*. Potsdam: H.F. Ullmann.

MacNeil, H. M., & Mak, B. (November 01, 2007). Constructions of Authenticity. *Library Trends, 56,* 1, 26-52.

National Library of Australia., & UNESCO. (2003). *Guidelines for the preservation of digital heritage*. Paris, France: Information Society Division, United Nations Educational, Scientific and Cultural Organization.

Paul, C. (2008a). *Digital art*. London: Thames & Hudson.

Paul, C. (2008b). *New media in the white cube and beyond: Curatorial models for digital art*. Berkeley: University of California Press.

Phillips, J. (2009). The reconstruction of video art. A fine line between authorised re-performance and historically informed interpretation. In I. Schubiger (ed.) *Reconstructing Swiss video art from the 1970s and 1980s* (pp. 158-165). Zurich: JRP Ringier.

Rinehart, R. (2003). MOAC - A Report on Integrating Museum and Archive Access in the Online Archive of California. *D-lib Magazine, 9,* 1.

Reinhart, R. (2007a). Museums and Online Archives Collaboration. Digital Asset Management, Database [2007], accessed March 27, 2012. Available at, http://www.bampfa.berkeley.edu/media/DAMD_Online_Documentation.pdf

Rinehart, R. (2007b). The Media Art Notation System: Documenting and Preserving Digital/Media Art. *Leonardo, 40,* 2, 181-187.

Rodger, E., Jorgensen, C., & D'Elia, G. (2011). Partnerships and collaboration among public libraries, public broadcast media and museums: current context and future press stable. *The Library Quarterly*, *75*(1), 42-66.

Ross, S. (2002). Position Paper on Integrity and Authenticity of Digital Cultural Heritage Objects. *Digicult: Integrity and Authenticity of Digital Cultural Heritage Objects, 1*, 6-8.

Ross, S. (2006). Approaching Digital Preservation Holistically. In A. G. Tough, & M. S. Moss (Eds). *Record keeping in a hybrid environment: Managing the creation, use, preservation and disposal of unpublished information objects in context* (pp. 115-153). Oxford: Chandos Press.

Ross, S. (2007). Digital Preservation, Archival Science and Methodological Foundations for Digital Libraries. Keynote address at the European Conference on Research and Advanced Technology for Digital Libraries (ECDL) 2007, Budapest, Hungary, 17 September 2007. Available online at, http://www.ecdl2007.org/Keynote_ECDL2007_SROSS.pdf

Stirling, B. (2003). Digital Decay. In A. Depocas, J. Ippolito, C. Jones, & Daniel Langlois Foundation for Art, Science and Technology. (Eds). *Permanence through change: The variable media approach = La permanence par le changement : l'approache des médias variable* (pp. 10-22). New York: Guggenheim Museum Publications.

Timms, K. (January 01, 2009). New Partnerships for Old Sibling Rivals: The Development of Integrated Access Systems for the Holdings of Archives, Libraries, and Museums.*Archivaria, 68*, 67-96.

Trant, J. (December 01, 2009). Emerging convergence? Thoughts on museums, archives, libraries, and professional training. *Museum Management and Curatorship, 24,*4, 369-387.

Walker, A. (2006) Preservation. In J. H. Bowman (ed). *British Librarianship and Information Work 2001-2005* (pp. 501-518). Farnham: Ashgate Publications.

Woolgar, S. (1996). Technologies as cultural artefacts. W. H. Dutton, & M. Peltu (Eds). *Information and communication technologies: Visions and realities* (pp. 87-102). Oxford, UK: Oxford University Press.

Yarrow, A., Clubb, B., & Draper, J.-L. (2008). *Public libraries, archives and museums: Trends in collaboration and cooperation*. The Hague: International Federation of Library Associations and Institutions.

Zorich, D., Waibel, G., Erway, R., & OCLC. (2008). *Beyond the silos of the LAMs: Collaboration among libraries, archives and museums*. Dublin, Ohio: OCLC Programs and Research.

Discussion Topics

Practical Issues in Preserving Software Art

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Introduction

The preservation of software art is both a research field in its infancy and an emerging field of practice. Software art is gathering a critical mass with museums, galleries and arts funds[1], which has prompted debates on the issues of collecting, curating and preserving unstable media art. Recognising the challenges deriving from this changing landscape, the POCOS Symposium on Software Art invited participants to actively engage in sharing knowledge and expertise through breakout sessions. The purpose of these sessions was to examine four key themes for delineating and advancing the state-of-the-art in preserving software. The themes focused on the role of the artist in the preservation process; the ramifications of storage, access and preservation technologies; the importance of documentation and interpretation; as well as legal and ethical considerations in preserving (collections of) software artworks.

The participants for the sessions came from a variety of professional contexts including: long-term digital preservation research and development; Fine Arts; government policy making; memory institution curation; and museum/gallery art conservation. With this eclectic mix of contributors from a variety of user and stakeholder communities, it was important not to make assumptions about prior knowledge but instead focus on the topics that constitute the preservation of software art practical, expedient and relevant. This paper is culled from the breakout sessions and summarises the questions, major issues and conclusions identified by the symposium participants in each of the four key themes.

The Role of the Artist

Within an ever-changing socio-cultural landscape, which is influenced as much by political economy as by technological evolution, notions of the remit of artistic practice have equally shifted from the mere production of artwork (both object and action) to what theorist Sven-Olov Wallenstein calls “a kind of ‘social service’” (Wallenstein, 2006). His argument relates this development to the role of the artist, noting that “[i]f we relate this to the way in which the artist-institution complex changes, then one of its effects would be the incorporation into the role of the artist of other functions - administration, pedagogy, marketing, consulting, etc...” (Wallenstein, 2006, p. 118)

[1] For instance, M Shed in Bristol and the Royal Albert Memorial Museum (RAMM), both involved in commissioning software art, have been have been longlisted for the Art Fund Prize 2012. For more information, see: http://www.artfundprize.org.uk/2012/longlist.php

Another such 'service' that artists are called to provide is that of curatorial responsibility. With software art having only recently – at least compared to more traditional forms – attracted the attention of cultural institutions in a more sustained manner (i.e. beyond the occasional exploratory avenue), software artists are faced with the practicalities of their involvement in the curation and preservation process of their own outputs. Institutional critique – a common occurrence within the institutional framework (Sheikh, 2006) – in the digital age includes the artist's own role. With digital preservation being a constantly evolving field, the blurring distinction between these emergent roles calls for investigation into the software artists' responsibilities in the preservation/curation lifecycle of digital objects.

From a practical standpoint, two main areas of involvement can be discerned: (a) the role of the software artist in preserving the integrity of the artwork itself, and its definition; (b) the demarcation of the responsibilities and rights of the artist within an institutional context.

Defining and Preserving the Integrity of Software Artworks

The symposium participants agreed that *preserving integrity* can only be meaningfully defined by the artist via documentation processes, in whatever form these may take. The documentation one chooses to produce varies and the artist's intentions vary in terms of the documentation produced. This 'bidirectional' variability suggests that there exists no "one-size-fits-all" method for producing documentation to help curators preserve a software artwork. Instead, documentation is perceived by artists as a subjective process – and to a certain extent, a creative process – with very different drivers for different stakeholders; for instance:

- software artists wanting to preserve more carefully those chunks of code that they feel they could reuse. *Immediate reusability* is the driver;
- demonstrating the value of the work to funders;
- the element of perceived significance about one's work;
- documentation as a facilitator of collaboration;
- documentation as validation of one's work and as part of a portfolio.

Documentation for curatorial purposes is viewed as less important or obscured by layers of institutional policies, which – in the participants' view – focuses heavily on the artwork itself as an *object*. However, software art relies on objects but is not necessarily *the* objects. In this sense, documentation as a means of preserving integrity cannot follow a rigid, standardised template. Tangibles – for instance the code, the monitors, the hardware and software – are only one part of defining integrity of the work. Other types include instructions for re-enactment; narrative which covers the artist's intent; description of the physicality of the work, in case it renders differently in future instantiations; definition of importance for different elements of multipart works; and contextual information related to the work (place, time etc.)

Documentation alone is not sufficient for preserving the integrity of software artworks. There exists a huge arena of factors that influence continuing access and preservation, which include: permissions for curation and reuse and the degree that changes are allowed by the artist; and interpretation influencing significance within the context of art history (what follows after the work has been exhibited). Taking these factors into account, a distinction is drawn between documenting and artwork for digital curation and

documenting for future audiences. This distinction is fuelled by an ongoing debate of *functionality* versus *form of media*. Technology can drive process-based artworks, but procedural aspects of preservation can include other parts of the work's integrity. Ultimately, the actual meaning of the work can be overtaken by obsessively emulating on a server system. Are we therefore too fixated on the tangible?

Roles, Responsibilities and Rights of the Artist

The artist *per se* is only part of a triad of roles that should be responsible for the long-term preservation of software artworks; the other two are curators and audiences. It is inevitable – and accepted – that gaps in expertise will appear, particularly with artworks that employ cutting-edge, bespoke technology. The question is to what extent these gaps, if left unnoticed, can impede preservation of software artworks or lead to them failing completely. Software art challenges the role of the curator as the definitive expert. Potential tension is seen as the aftermath of the race to prove who is the arbiter of value, expertise and preservation responsibility. This tension is further fuelled by a feeling of 'rightfulness': who has authority over definitions of integrity? Is it permissible for curators to make changes to the 'tangibles' (e.g. hack the code) to preserve the functionality/behaviour? Is behaviour usually more central to integrity than the medium/algorithm/code? In practical terms, the answer can only be specific to the context of individual cases, and both artists and curators feel reluctant to expose themselves to the criticism of endorsing/proposing 'rules' and 'best practice' that will simply not work catholically.

Conclusion

In summarising the role of the artist in preserving software artworks, the symposium participants felt that the focus should be on preserving the essence of the work rather than the objects and technologies that manifest that essence. At present, the onus remains with the artist to help preserve the artwork. This is partly because the technological complexity of software artworks can only be fully comprehended by the creator. Intrinsic to this realisation (for both artists and curators) is the sense of urgency in that degradation of a software artwork can have immediate effects (as opposed to, say, a slowly degrading painting). Artists are aware of the benefits of facilitating the curation/preservation process of their work, but are at the same time challenged by the time, cost and expertise burden and the underlying feeling that – without taking the initiative – no one else will.

The Role of Cultural Institutions: Storage, Access and Preservation Technologies

In considering the role of cultural institutions (archives, libraries, museums and galleries) in terms of storage, access and technologies suitable – or otherwise - for the preservation of software art, a number of key questions emerge that contextualise the practical issues within the topic:

- What kind of tools are artists dealing with to create art? (PC hard drives?)
- How do the semantics survive different tools / scenarios?
- What about the technological divide between creator and curator?
- How can the storage media possibly make any difference to the artwork?
- Is preserving software art a special case?
- How do file formats affect software art?
- Is it just the image formats that are important, or is it the code as well?
- Does it matter whether we use migration, emulation or virtualization?
- Are there any file formats that are particularly suited to software art?

Five key themes derived from the consideration of these questions, which can broadly be summarised as (a) conservation and acquisition; (b) the artist's intention; (c) the original context of the artwork; storage media/file format issues; and (e) the selection of an appropriate preservation strategy between emulation and migration alternatives.

Conservation / Acquisition

For some large memory institutions, it may be the case that the whole aspect of curation can be (accidentally) left out of the process of commissioning and purchasing software art, and it is therefore vital for curators to become more involved right from the start. Indeed, for some departments not engaged in storing current artworks, there is a need for education regarding what different types of software art are already in existence. In particular, how are such artworks deposited – on a disk? Are there any established acquisition procedures? Are requirements carefully documented, and are there any templates / guidance for this? What about artworks that are mixtures of physical and digital material – how can these be successfully conserved? An example that highlights this problem is that of a key object (an escalator) that has broken down, and the artist is deceased so it is not possible to ascertain the artist's intention (although their estate was contacted in this respect). The artwork in question was highly complex, containing various sensors.

The whole part physical / part digital object issue is an interesting one, and one that also appears in the preservation of visualisation / simulation debate. It is very important that such a hybrid complex object is treated correctly as a hybrid software art piece, with rules and conventions covering all aspects of the work, instead of there being one set of rules governing the physical aspect, and another for the digital. For example, some museums, such as the Science Museum and the Conservatoire national des arts et métiers (CNAM) in Paris, hold objects such as computers that may be preserved in non-working order. This may not be a suitable strategy for a hybrid software artwork containing such an object. It is also vital to ensure that all parts of a hybrid artwork are housed together and not sent to separate institutions. It is paramount to record all the information

pertaining to creating and preserving the artwork, and to be aware that for some memory institution artefacts the medium used may not be important, but for software art it may be crucial. The materiality of the artwork needs preserving.

What is the Artist's Intention?

When considering a multi-faceted, multi-layered, possibly hybrid artwork, it is of primordial importance to know the artist's original intention as a reference point for any subsequent representation of the artwork. We need to know what metrics the artist is using, and what are the parameters concerning time, space and social engagement. Clearly it may be very difficult for some artists to decide what they need to record, whereas others such as boredomresearch are extremely well versed in what they need to provide. Indeed, it may be that artists need to learn a software craft in the same way as learning a painting craft. Of course, some artists may not have an intention, and some may have one, but not want to declare it deliberately: after all, freedom of expression is crucial in art. Capturing intent can be very elusive: files can be saved, but if they are not rendered correctly, the artistic effect / message may be lost.

A particular piece of software or hardware may or may not be significant, according to the artist's intentions, and no prior assumptions should be made here. This becomes more and more taxing as ways of digital representation change and we now have artwork on handheld mobile devices etc. There is also a different culture in art circles that affects software art: this involves the whole domain of secondary representations, made by the artist, or by others. When a software artwork forms the basis of such a representation, how can the original work be conserved as a separate artefact, with associated monetary and cultural values? There are parallels here with the old problem of conservation versus restoration as they affect the integrity of the artefact. The artist may also wish to exercise a prerogative to change his or her intention, which may be acceptable, but it may not be appropriate for someone else to change it.

It is vital to appreciate the different shades of physicality when an artwork is virtualized or emulated, and to ascertain how these affect the artist's intent in terms of the performance of that instance of the work. If an artist's intentions are clear, should they need to worry about preservation? What might be helpful for the artist is to provide templates, protocols, models to follow, with an instantiation as a concept covering issues such as generalisation / specialisation; craft / bespoke; top-down / bottom-up etc. After all, Jackson Pollack is not repeatable. Any variable component in the artwork poses particular difficulties, as it is especially important for the artist to specify what is really significant in this case. For example, in an artwork comprising a movie of a glass of water with moving bubbles, the factors that were important were that the bubble images be projected in colour, and the projector screen size was significant.

What about the original context of the artwork?

Following on from this thought, the printer in the Brutalissmo[2] sculpture at the Tate museum was deemed not to be significant for the artist, but in terms of art history it is important. Any changes in the technical environment of any artefact need to be carefully tracked – does it matter if just part of an artwork is replaced – how does that affect the quintessence of the piece? Such issues were discussed at the Digital Materiality workshop at the British Library that looked into personal archiving and explored the importance of keeping the original context as well as the artist's documentation etc. Preserving an original instance plus a description of functionality, together with a working instance is helpful. Keeping a video of the original performance is also advisable, and helps with interpretation of the initial historical influences.

What are the storage media / file format issues?

A salient issue is "to what extent do the file formats / tools shape the artwork?" For example, software like Director can be influential for a short while, but then its influence just fade away. Tools can filter the experience: for example, JPEG is a format that suits average visual needs, such as organic material like skin, but it does not cope well with shadow, making it a file format with an agenda. The format used will affect the quality of the artworks: it would be interesting to know the range of formats currently used in this field. The analogy for cinematography is that of keeping master files on Kodak disks: any proprietary changes by Kodak will affect these files. (Of course, with film going digital, there will soon be a massive phase shift in the way film is preserved.) Even within current standards, there will always be favoured / recommended levels of compression, preferred media etc. Not all formats provide the same repeatability: the quality diminishes with some of them.

For archivists in a broadcasting company, there is always the issue of chasing the latest technologies. Although archivists may just wish to re-use the artwork, in practice, to do this they need to be nearer the producers / creators of the material. In the debate about what to save: the edits, raw originals or final cut; the preferred practice appears to be saving everything, despite the number of backups, as it is too costly to select, and it seems better not to repeat the experience of wiping the material in the 1950s. There are real difficulties with preserving DVDs as you cannot inspect every one of them, and 1 corrupt bit on a DVD can destroy the entire contents, whereas a speck of dust on a film can be cleaned off and corrected. Keeping multiple copies can help overcome this problem (Reich & Rosenthal, 2001).

There is also the issue of interdependent components within some types of software, such as Macromedia Director, which produces many files. Using this software has the bonus of cheaper storage, but this may be eventually outweighed by the complexity of the file storage. Likewise it may be tempting to rely on Open Source communities, but this may also be a false economy if such material is not supported and developed. A database of software art objects would be helpful, with each object having a child record for digital

[2] Reference is made here to the artwork by José Carlos Martinat, *Stereo Reality Environment 3: Brutalismo* (2007) . The artwork has been exhibited at the Tate Modern; source: http://www.tate.org.uk/art/artworks/martinat-mendoza-brutalism-stereo-reality-environment-3-t13251

information. The *Forging the Future* project[3] is an important source of information, with free tools.

Which Digital Preservation Strategy – emulation or migration?

The tools used for creating the software artworks can be a bridge to emulation later, as it is vital to acknowledge the relationships between software and hardware used to make the artefact. Too many changes to the artwork under migration might change it fundamentally, as its significant features may have been altered (Dappert & Farquhar, 2009). Another issue is to try to decide which is more important: preserving the original software and hardware in working condition, or emulating this technical environment? Is the artwork still considered original if it is run under emulation? There does not seem to be a single solution: rather emulation and migration should be considered according to their merits on a case-by-case basis.

Conclusion

The group of participants studying this area concluded that software art does stand out as a unique case, with hybrid physical / digital artworks, the primacy of the artist's intentions and the effect the file formats / storage media may have on the performance and pecuniary and cultural value of the artefact. There does not appear to be a single one-fits-all preservation solution.

Legal and Ethical Responsibilities

There are a number of different ethical approaches which might be applied in the context of software art. A general definition of 'ethics' might be "Honesty, fairness and equity in interpersonal, professional and academic relationships" (Covey, 1991). However, there are a number of different, more specific, ethical approaches which might be applicable.

The first of these is 'Utilitarianism' where the principle of 'Utility' is applied to all ethical decisions. The origins of utilitarian theory can be traced back to ancient Greek philosophy where, for example, Aristotle argued that eudaimonia[4] is the highest human good. The modern articulation of utilitarianism did not appear until the 19th century and is generally credited to Jeremy Bentham. The core insight which drives utilitarian thinking is that morally appropriate behaviour will not harm others, but will instead increase happiness or 'utility'. Bentham, following in the tradition of hedonism, sees pleasure as the only intrinsic good and pain as the only intrinsic bad. These twin claims lead directly to the notion that an act is morally right if and only if that act causes "the greatest happiness for the greatest number".[5] Utilitarianism is generally considered to be a consequentialist normative theory.

Another approach is deontological ethics[6] In contemporary moral philosophy, deontology is any normative theory concerning which choices are morally required,

[3] http://forging-the-future.net/
[4] This is usually translated as 'happiness'.
[5] For a good discussion of Utilitarianism see: http://plato.stanford.edu/entries/consequentialism/#ClaUti
[6] The word deontology derives from the Greek words for duty (deon) and science (or study) of (logos).

forbidden, or permitted, independent of their consequences. Deontologists generally believe that that some choices cannot be justified by their effects, and therefore some actions are morally forbidden no matter how good their consequences. In short, 'ends' do not justify 'means'.[7]

Based on these approaches, the symposium participants distilled the practical application of ethical codes specifically within the domain of software art. The findings are summarised in the following section.

Practical Application of Ethical Codes

Ethical considerations arise in relation to:

- the Creator of an artistic work,
- the Commissioner or Owner/Holder of the work and
- the wider audience of the work

There are two other ethical considerations:

- What is 'the wider Public Good' and how can this be identified and
- Are there ethical issues implicit in an artwork – for example if an artwork might be responsible for the emission of large amounts of CO2 through the use of electrical energy or consumption of paper etc.

The question initially arises as to whom the artist creates for and to what extent the interests of one party dominate over the others. It is also important to recognise that there may be intersections and/or conflicts between the ethical stances of the museums and galleries and the artists themselves. Such conflicts may also arise between the artist and an organisation seeking to preserve their work. One of the possible causes of ethical conflict is that the significance of an art work and what it means to the viewer may differ from the original intentions of the creator. Similarly, the tri-partite relationship between Creator, Holder and Audience may be affected over time and by the creation of subsequent, associated material from other sources.

A unique relationship in digital art which must be considered is that of the source code which creates the object and that object itself. While a creator may wish to prescribe what is to happen to their creation, the capability for a third party to modify the source code to amend the object is a unique property of digital art. If any artwork is intended by the artist to represent one or more 'truths', the preserver may not have a particular interest in those 'truths' or may wish to focus on only one of them. In addition, the costs of digital preservation may influence the choices which are made in the selection of objects to be preserved. As a result, the selection of objects for preservation may be influenced by measurements other than those of their cultural significance. It is also important to recognise that such debates may also be influenced by religious considerations.

One possible approach to these ethical problems is to remove judgments about the worth of an object and to focus on the object itself. It was noted in discussions that the Rosetta Stone escaped destruction because it was seen at the time of being of little importance. It is also important to understand the differences between the preservation of a record and that of an art form. There is currently little understanding of the life cycle of an artwork from Creation to Globalisation to Destruction.

[7] For further discussion see: http://plato.stanford.edu/entries/ethics-deontological/

There is a new ethical challenge for curators to justify non-preservation. Pub-licly-funded institutions are audited for how they spend money, leading to a strong focus on a Value For Money process. This is a new process to confront digital art and will require the preparation of new business models. Similarly, while the long-term conservation of books is a process which is con-trolled by a well-developed set of rules on Intellectual Property, these have not yet been evolved to cover digital art.

It must be recognised that all art seeks to create an emotional response, and the presentation of an artwork may be non-rational. Understandings of the object will be different for each viewer, and their emotional response will also differ depending on individual interpretation. Digital art is by its nature dynamic, and it therefore also important to capture both the context and the provenance of the object. Ethical approaches, however, apply to what conservators do, not to the object itself. There is therefore the need for an ethical framework which encompasses each agent in the lifecycle of the artwork. It is important to understand, however, that such a framework cannot be imposed but must be willingly accepted. In addition, such a framework is likely to create competition between different ethical standpoints.

Firstly, the start-point of any ethical framework must be identified, and it was accepted that this would mean the Commissioner of the artwork, who should be encouraged to consider issues of preservation from the beginning. Similarly, the Creator of the work has an ethical duty to take preservation into account during the process of creation. There is, however, a potential for conflict here between the moral rights of the Creator with the property rights of the Commissioner. Many of these rights cannot be simply bought or sold, and rights-holders expect the law to uphold their rights. Finally, the Curator / Preserver has ethical responsibilities towards the artwork with which they are entrusted.

If one accepts that the purpose of an ethical code is to ‘prevent harm’, the question to be answered is how one can cause harm during digital preservation? To answer this, it is necessary to create a methodology to identify and quantify potential harms arising from the preservation of an object. This will require trusted assessors and common indices. There is a risk, however, that a purely arithmetic process will be inadequate. The reputation of any process will be critical to its acceptance. It must therefore be supported by an appropriate hierarchy of decision-making so that decisions are taken at the right level, and the overall integrity of the process is established over a long period of time.

The key factors identified by discussion were as follows:

- Doing no harm to people
- The ethical dimension applies to the actions people take, not the objects them-selves

Any digital preservation process must contain:

- Integrity
- Transparency
- Authority
- Accountability
- An arithmetic approach is inadequate
- Digital Preservation must be incorporated into the Commissioning and Creation Process
- Digital Preservation must take account of any prior considerations relating to the digital object
- There is a need to balance the duty to preserve against the context of the object

There are additional considerations for museums and galleries. Firstly, there is an assumption that once an object is accepted into an institution, it will be treated as if it is to be preserved. For this reason, that institution's ethical framework must begin with preservation planning. Connections and sources related to digital art must be documented. The meeting agreed that it would be unethical to accept an object unless the provenance has been established. The organisation's preservation policies should incorporate an ethical viewpoint, and should differentiate clearly between 'restoration' and 'conservation'.

Conclusion

An organisation with responsibilities for curation of digital art should only make commitments to preservation which it is within their power to fulfil. Failure to do this would in itself be unethical. The institution should also possess a framework to enable it to calculate the relativities of harm in different preservation approaches, and ensure that its preservation activities are entirely consistent with the ethics of its institutional mission.

> *"The development of complex digital objects leads to the creation of complex ethical models" – William Kilbride, Digital Preservation Coalition*

Bringing it all together – a preservation strategy?

With preservation of software art being a field in its infancy, it is no surprise that exploring the requirements for a preservation strategy generates more questions than answers. The POCOS Symposium has highlighted in the most generic terms, the repeated signal from both communities of software artists and curators for a continuing dialogue that reflects on an appreciation of the issues involved in preserving complex visual artwork. For this dialogue to be meaningful, there is a growing demand for extensions beyond the artist/curator microcosm that will reach decision-making and policy construction in culture heritage institutions. This dialogue between artists and institutions (either mediated by curators or otherwise) must allow for information flow both horizontally and vertically and result in a continuous stream of dissemination and information exchange regarding innovative research, emergent artistic practices and forthcoming curatorial/preservation processes.

At present, it becomes evident that an immediate, all-encompassing solution is idealistic. Competing positions – and their repercussions – tip the balance in software art preservation. From the one hand, the adherence to recording comprehensive metadata and thoroughly documenting the process of scientific research behind software art for the sake for re-instantiation is viewed by cultural institutions as part of the return in their investment. On the other hand lies the defiance of performance arts (of which software art can be seen as a genre) against the obligatory 'institutionalisation' and the obligation to become reproducible.

With an array of dependencies on software and hardware – and the torment of obsolescence that these entail, the only viable parameters in a preservation strategy is the realisation that experimentation with new techniques, such as emulation and virtualisation is required (let alone inevitable); and the need to work with 'acceptance parameters' that indicate how much of the artwork can be reasonably expected to become lost, and what can realistically be saved. These parameters imply an underlying 'community consensus'

on the content and extent that preservation parameters are considered acceptable. The need for community support has been signalled repeatedly and, in many instances has worked well[8], but also generates a host of questions:

- Who would initialise and coordinate communication within and among communities? The paradigm of fan-based communities (predominantly in the realm of video gaming) has offered digital preservation some remarkable lessons, but can it work within the context of software art?
- What are the requirements for central facilities, expertise and training in preserving software art? For some of the participants, the responsibility in these areas lies with cultural institutions; but do they have the technological capability to act as the arbiters of expertise?
- Crowdsourcing has been cited as a potential solution to conglomerate expertise and alleviate costs from individuals and institutions to document and understand technologies. Can crowdsourcing present a valid approach to preserving software art? The public must perceive that software art should be saved, in order to be brought into the curation/preservation process. In such a case, should we hand them the 'can of worms', shifting the responsibility from the traditional custodians of cultural heritage?

Besides raising these questions, the POCOS symposium reached a provisional solution toward approaching a preservation strategy for software art: to work at present on a case-by-case basis, within broad rules. In the pages of this volume, some of these 'rules' are presented and explained and can hopefully shed light on the grey areas of software art preservation. By collating these rules, ideas and research outputs, the symposium has provided a platform for raising awareness and setting the groundwork toward a future formulation of standards and construction of institutional policies that explicitly appreciate the issues pertaining to software art and the requirements for its long-term preservation. Specifically, the symposium recommended the forming of a strategic grouping of all interested parties that would work together to bring these aims into practice.

References

Covey, S. R. (1991). Principle-Centered Leadership. New York: Summit Books.

Dappert, A., & Farquhar, A. (2009). Significance Is in the Eye of the Stakeholder. Paper presented at the ECDL2009. http://www.planets-project.eu/docs/papers/Dappert_Significant_Characteristics_ECDL2009.pdf

Reich, V., & Rosenthal, D. S. H. (2001). LOCKSS: A Permanent Web Publishing and Access System. D-Lib Magazine, 7(6).

Sheikh, S. (2006). Notes on Institutional Critique. EIPCP Multilingual Webjournal Retrieved from European Institute for Progressive Cultural Policies website: http://eipcp.net/transversal/0106/sheikh/en

Wallenstein, S. O. (2006). Institutional Desires. In N. Möntmann (Ed.), Art and Its Institutions : Current Conflicts, Critique and Collaborations. London: Black Dog Publishing.

[8] See for instance the ACM SIGGRAPH (Special Interest Group on GRAPHics and Interactive Techniques) community: http://www.siggraph.org/

Appendix

Biographical sketches for lead authors (in order of appearance)

Dr. William Kilbride is Executive Director of the Digital Preservation Coalition, a not-for-profit membership organization which provides advocacy, knowledge exchange, workforce development, assurance and partnership around issues of digital preservation. The DPC has around 40 organisational members across the UK and Ireland and is active in a number of international research initiatives and partnerships. William started his career as an archaeologist in the early 1990s when the discipline's enthusiasm to use technology was not matched with the skills to look after the resulting data. This gave him an early and practical introduction to the challenges of data management and preservation. He was previously a lecturer in Archaeology at Glasgow University where he retains an honorary position, Assistant Director of the Archaeology Data Service at the University of York and Research Manager with Glasgow Museums.

Dr. Janet Delve is co-leader of the Future Proof Computing Group, one of the research clusters in the Centre for Cultural and Industrial Technologies Research (CiTech) at the University of Portsmouth. She holds degrees in Mathematics (UCL), French (Southampton), together with a Master's degree in Microwaves and Modern optics (UCL), and a PhD in the History of Mathematics (Middlesex University). Her research interests include: metadata modelling for digital preservation; data warehousing applied to cultural domains; and the crossover between the history of computing and digital preservation. The University of Portsmouth is a partner in the EC FP7 Project KEEP, in which Janet is responsible for the data modelling of complex digital objects and the development of the technical environment metadata database, TOTEM. She is a member of the AHRC Peer Review College.

Prof. Simon Biggs was born in Australia in 1957 and moved to the UK in 1986. He has been making art with digital media since 1978, which has been presented at Tate Modern, Centre de Georges Pompidou, Academy de Kunste, Rijksmuseum Twenthe, Macau Arts Museum, SF Cameraworks, Walker Art Center and Art Gallery of New South Wales. He has been keynote at many conferences, most recently Cornell University's 2010 Society for the Humanities Conference. Publications include Autopoeisis (with James Leach, 2004), Halo (1998), Magnet (1997), Book of Shadows (1996) and Great Wall of China (1999). He is Professor at Edinburgh College of Art. http://www.littlepig.org.uk

Dr. Leo Konstantelos is Principal Investigator for the POCOS project at the University of Glasgow and a Research Fellow at the University of Portsmouth. He holds an MSc in Information Technology (2005) from the Department of Computing Science at the University of Glasgow; and PhD in Humanities Computing (2009) from the Humanities Advanced Technology & Information Institute (HATII). His doctoral thesis presents an empirical investigation of the problems of including digital art in the context of Digital Libraries. Leo has worked in a number of EU-funded projects, including *Preservation and Long-term Access through NETworked Services* (Planets); *Sustaining Heritage Access through Multivalent ArchiviNg* (SHAMAN); and *Keeping Emulation Environments Portable* (KEEP). His research interests are in applications of technology in digital curation and digital preservation, with a particular emphasis on complex digital objects. Leo has lectured widely on issues pertaining to the broader field of Information Studies, Information Management and Digital Media.

Michael Takeo Magruder is an artist and researcher based in King's Visualisation Lab, located in the Department of Digital Humanities, King's College London. His projects have been showcased in over 200 exhibitions in 30 countries and his writings have been published in various academic books and journals. Michael's practice explores concepts ranging from media criticism and aesthetic journalism to digital formalism and computational aesthetics, deploying Information Age technologies and systems to examine our networked, media-rich world. His research focuses on the intersections between contemporary art, emerging technology and interdisciplinary practice. Michael received his formal education at the University of Virginia, USA and graduated in 1996 with a BSc (Hons) in molecular biology. He is a STEM (Science, Technology, Engineering and Mathematics) ambassador for Thinktank Birmingham Science Museum and regularly lectures about interdisciplinary arts practice and the potentials of creatively blending art, science and technology.

boredomresearch is a collaboration between Southampton UK based artists **Vicky Isley** and **Paul Smith**. The collective are internationally renowned for creating software driven art, highly aesthetic both visually and acoustically. boredomresearch has shown at festivals, galleries and museums world-wide including most recently KUMU Art Museum in Tallinn, Estonia (2011); [DAM]Cologne (2011); Electrohype Biennale, Ystad Art Museum, Sweden (2010); FILE Prix Luz, SÃ£o Paulo (2010); Today Art Museum, Beijing (2010); LABoral Centro de Arte y Creacion Industrial, GijÃ³n, Spain (2010). Their artwork 'Ornamental Bug Garden 001' is housed within the British Council's Collection and has been awarded honorary mentions in Transmediale.05, Berlin (2005) and VIDA 7.0 Art & Artificial Life International Competition, Madrid (2004). Currently they are both Research Lecturers in Computer Animation & Computer Art at the National Centre of Computer Animation, Bournemouth University UK.
http://www.boredomresearch.net/

Daisy Abbott started her career researching digital culture and digitisation efforts across the world before moving into digital documentation of performing arts research. She worked as a digital curation advisor before moving to her current position as a research developer specialising in 3D digital documentation and visualisation technologies and methods, across the heritage, arts, and medical domains. She comes from a background in theatre, film and television studies and IT. Daisy's research interests span various aspects of the creation and continuing use of digital information. Specific areas of interest include: digital representations of ephemeral events and how these representations affect performing arts scholarship and curation methodologies; interaction design; performed heritage; use of digital documentation in education or recreation and the development of new digital pedagogies; information retrieval; standards for digital arts and humanities; digital curation; and serious games.

Perla Innocenti is Research Fellow in History of Art, University of Glasgow, where she is conducting interdisciplinary research on preservation for digital art and cultural heritage informatics as Principal Investigator of the EU FP7 project MeLA and Co-Investigator of the EU FP7 projects ECLAP and SHAMAN. She was Co-Investigator of the EU FP7 project DL.org (digital libraries interoperability) and collaborated to the development of the EU digital preservation projects FP6 DPE (repository design and risk assessment, in collaboration with UK Digital Curation Center), Planets (usage models) and CASPAR (certification and trusted repositories). Prior to this, Perla was at

Politecnico di Milano, Italy researching information systems for industrial design and coordinating digital libraries activities and projects. She also conducted museology research and collaborated on museum exhibitions with various Italian institutions, including Scuola Normale Superiore di Pisa; Istituto Nazionale di Archeologia e Storia dell'Arte in Rome; Pinacoteca Nazionale di Bologna, Electa-Mondadori. Perla holds a degree in History of Modern Art from University of Rome La Sapienza, and a Master in Management and Communication of Cultural Heritage from Scuola Normale Superiore di Pisa. The results of her research have been presented and published in international conferences, journals and books. Innocenti's papers, projects, and more can be found at http://www.gla.ac.uk/schools/cca/staff/perlainnocenti/

Clive Billenness holds the post of EC Project Management Expert at the British Library. He is currently the Project Manager for POCOS and also a workpackage lead on the EC FP7 Project KEEP as well as a member of the British Library's project team on the EC FP7 Project SCAPE. Qualified in Prince2, MSP and M_o_R, Clive was the Programme Manager of the Planets Project and a member of the team which created the Open Planets Foundation. He is a Certified Information Systems Auditor. As a Head of the Northern Region's Public Sector Information Risk Management Team at KPMG LLP, Clive was responsible for directing a review on behalf of the National Audit Office of the £30m project to update the Department of Work and Pensions computer systems. He also advised the UK Office of Government Commerce and the Office of the UK Deputy Prime Minister on a number of IT Projects. Prior to this, Clive was a Regional Service Lead for the Audit Commission where he was frequently loaned to clients to assist with the recovery of projects which were in exception. Clive is a member of the Office of Government Commerce's Examining Board for Project, Programme and Risk Management examinations. He is also a Director of the UK Best Practice User Group for the same disciplines. Clive is a regularly published author for the Chartered Institute of Public Finance and Accountancy (CIPFA) on Project Management.

Glossary

Access: the process of turning an *AIP* into *DIP,* ie using data from a digital archive
ADF Opus: A Microsoft Windows–based program to create *ADF*
ADF: Amiga Disk File, a file format used by Amiga computers and emulators to store images of disks
ADS: Archaeology Data Service, a digital archive specialising in archaeological data based in York
AHDS: Arts and Humanities Data Service, a data service for higher education, closed in 2008
AIMS: Project funded by Mellon foundation to examine archival principles in the digital age
AIP: Archival Information Package, a package of information held within an *OAIS*
APA: Alliance for Permanent Access, a European network, set up *APARSEN*
APARSEN: a Network of Excellence funded by the *EC*, see *APA*
API: an interface provided by a software program in order to interact with other software applications
Archival Storage: The *OAIS* entity that contains the services and functions used for the storage and retrieval of *AIP*
ARCOMEM: ARchive COmmunities MEMories, *EC*-funded project in digital preservation
ASCII: American Standard Code for Information Interchange, standard for electronic text
BADC: British Atmospheric Data Centre
BL: British Library
BlogForever: *EC*-funded project working on robust digital preservation, management and dissemination facilities for weblogs
BLPAC: British Library Preservation Advisory Centre – a service of the BL which promotes preservation
BS10008: a British standard pertaining to the evidential weight of digital objects
CCSDS: Consultative Committee for Space Data Systems, originators of the *OAIS* standard
CD-ROM: Compact Disc, read-only-memory
Characterisation: stage of ingest processes where digital objects are analysed to assess their composition and validity
Checksum: a unique numerical signature derived from a file. Used to compare copies
CiTech: Centre for Cultural and Industrial Technologies Research
Cloud (cloud-computing, cloud-based etc.): on demand, offsite data storage and processing provided by a third party
CRT: Cathode ray tube
CSP: Compound Scholarly Publication
CVS: Concurrent Versions System or Concurrent Versioning System, a client-server revision control system used in software
Data Dictionary: A formal repository of terms used to describe data
DCC: Digital Curation Centre, data management advisory service for research
DDC: Dewey Decimal Classification
Designated Community: group of users who should be able to understand a particular set of information

DigiCurVE – Digital Curation in Vocational Education, assessment project funded by EU on training provision in Europe
Digital Object: a set of bit sequences, e.g. a single document such as a PDF file, or an image of a (console) game, etc.
DIP: Dissemination Information Package, the data disseminated from an *OAIS*
DOS: Disk Operatins System
DP: Digital preservation
DPA: Digital Preservation Award, biannual prize awarded by the *DPC*
DPC: Digital Preservation Coalition, a membership body that supports digital preservation
DPTP: Digital Preservation Training Programme, an intensive training course run by *ULCC*
DRIVER: Digital Repository Infrastructure Vision for European Research
DROID: tool developed and distributed by TNA to identify file formats. Based on *PRONOM*
DSA: Data Seal of Approval, a process by which organisations can undertake self-evaluation of their DP practices
DVD: Digital Versatile Disk, formerly the same abbreviations was used for Digital Video Disk
EC: European Commission
Edina: a national data centre based in Edinburgh University mainly funded by JISC
Emulation Framework: a framework that offers emulation services for digital preservation
Emulation: adapts a computer environment so that it can render a software artefact as if it were running on its original environment
Encapsulation: a process where digital objects are captured with information necessary to interpret them
ENSURE: Enabling kNowledge Sustainability Usability and Recovery for Economic value, *EC*-funded project
EPSRC: Engineering and Physical Sciences Research Council, UK
EU: The European Union
FOAF: Friend of a friend, machine-readable ontology describing persons
FRBR: Functional Requirements for Bibliographic Records
GD-ROM: Giga Disc Read Only Memory, proprietary optical storage medium for the game console Sega Dreamcast
GIF: Graphic Interchange Format, an image which typically uses *lossy compression*
GIS: Geographical Information System, a system that processes mapping and data together
HATII: Humanities Advanced Technology and Information Institute at Glasgow University
HDD: hard disk drive
HEI: Higher Education Institution
HTML: Hypertext Markup Language, a format used to present text on the World Wide Web
IGDA: International Game Developers Association
Incremental: a project funded by *JISC* at HATII and Cambridge University
Ingest: the process of turning an *SIP* into an *AIP,* ie putting data into a digital archive
ISO: International Organization for Standardization, body that promotes standards
JISC: Joint Information Systems Committee of the Higher Education Funding Councils

JPEG 2000: a revision of the *JPEG* format which can use *lossless compression*
JPEG: Joint Photographic Experts Group, a format for digital photographs which is *lossy*
KB: Koninklijke Bibliotheek, national library of the Netherlands, partner in *KEEP* and *APARSEN*; *APA* home to *LIBER and NCDD*
KEEP: Keeping Emulation Environments Portable, EC-funded project to develop *emulation* services to run on a virtual machine
KVL: King's Visualisation Lab
LC: Library of Congress
LCD: Liquid Crystal Display
LED: light emitting diode
LIBER: network of European Research Libraries involved in *APARSEN* and *AP,* offices at the *KB*
LIDAR: Light Detection And Ranging, an optical remote sensing technology used to measure properties of a target using light or laser.
LiWa: Living web archives, *EC*-funded project which developed web archiving tools
LOCKSS: Lots of Copies Keeps Stuff Safe a DP principle made into a toolkit for E-Journal preservation, see *UKLA*
LOD: Linked Open Data
Lossless compression: a mechanism for reducing file sizes that retains all original data
Lossy compression: a mechanism for reducing file sizes which typically discards data
MANS: Media Art Notation System MANS
Memento: an innovative tool which allows time based discovery of web pages, winner of *DPA* 2010
METS: Metadata Encoding and Transmission Standard, a standard for presenting metadata
Migration: the process of moving data from one format to another
MLA: Council of Museum Libraries and Archives, strategic body for such organisations in England
MP3: digital audio format (standing for both MPEG-1 or MPEG-2 Audio Layer III)
NARA: US National Archives and Records Administration
NCDD: Dutch national digital preservation coalition, closely aligned with *APA, DPC* and *Nestor* and hosted by *KB*
NDAD: UK National Digital Archive of Datasets, formerly funded by *TNA* and operated by *ULCC*
NDIIPP: National Digital Information Infrastructure and Preservation Programme – a major programme from the *LC*
Nestor: German network of expertise in digital preservation, closely aligned to APA and NCDD
NRW: North Rhine-Westphalia, state of Germany
OAI-ORE: Open Archives Initiative Object Reuse and Exchange, standards for description and exchange of web resources.
OAI-PMH: Open Archives Initiative Protocol for Metadata Harvesting
OAIS: Open Archival Information System, a reference model describing a digital archive
OCLC: Online Computer Library Center, Inc., US-based library and research group
OMII-UK: open-source organisation that empowers the UK research community by providing software for use in all disciplines of research
Open source: software in which the underlying code is available for free
OPF: Open Planets Foundation**,** a membership organisation which sustains outputs from the *PLANETS* project

OSS: Open Source Software

Paradata: Information about human processes of understanding and interpretation of data objects, e.g. descriptions stored within a structured dataset of how evidence was used to interpret an artefact.

PARSE.INSIGHT: EC-funded project that developed a roadmap for DP infrastructure in Europe

PDF/A: a version of the PDF standard intended for archives

PDF: Portable Document Format, a format for producing and sharing documents

PLANETS: a project funded by the EC to develop a suite of DP tools including *PLATO*. Now maintained by *OPF*

PLATO: a *preservation planning* tool which was created by the *PLANETS* project

PNM: Preservation Network Model

POCOS: Preservation Of Complex Objects Symposia, a JISC-funded project which organised a series of three symposia on preservation of Visualisations and Simulations; Software Art; and Gaming Environments and Virtual Worlds in 2011-12

PREMIS: Preservation Metadata: Information Strategies, metadata standard

Preservation planning: defining a series of preservation actions to address an identified risk for a given set of *digital objects*

PrestoPRIME: *EC*-funded project which develops tools and services for the preservation of digital audio-visual content

PRONOM: a database of file formats with notes on associated issues. Used with *DROID*

PROTAGE: Preservation organizations using tools in agent environments, *EC*-funded project

PSD: Adobe PhotoShop file format

RCUK: Research Councils UK

RDF: Resouce Decription Framework

RIN: Research Information Network, a group that studies and reports on research needs

RLG: Research Libraries Group, US research group that produced *TDR*. Now part of *OCLC*

RLUK: Research Libraries UK

SaaS: software as a service, architecture whereby software is managed remotely by a service provider (see also *cloud*)

SCAPE: Scalable Preservation Environments, *EC*-funded project developing scalable preservation actions

SHAMAN: Sustaining Heritage Access through Multivalent Archiving, *EC*-funded project

Significant properties: concept whereby identifying the most important elements element of a file will aid preservation

SIP: Submission Information Package, data received into an *OAIS*

SKOS: Simple Knowledge Organization System, specivications on knowledge organisation system, developed by W3C

SPEQS: Significant Properties Editing and Querying for Software

SSMM: Software Sustainability Maturity Model

STFC: Science and Technology Facilities Council, UK

STM: Science Technology and Medicine – major area of publishing**,** sometimes meaning the STM Publishers Association

SWISH: joint venture between *RCAHMS* and *RCAHMW* to provide digital services including long term preservation

TDR: Trusted Digital Repository, a standard which characterises 'trust' in a digital archive
TIFF: Tagged Image File Format, a common format for images typically *lossless*
TIMBUS: an EC-funded project which is investigating the preservation of online services
TOTEM: Trustworthy Online Technical Environment Metadata Database
TRAC: Trusted Repository Audit and Certification, toolkit for auditing a digital repository
UBS: universal serial bus
UKDA: UK Data Archive University of Essex, digital archive for social and economic data
UKLA: UK *LOCKSS* Alliance, a service of *Edina* which offers E-journal preservation
UKWAC: UK Web Archiving Consortium
ULCC: University of London Computer Centre, host of *NDAD* and creators of *DPTP*
UMD: Universal Media Disc; proprietary CD-ROM format of Sony Computer Entertainment
UML: an industry standard for visualisation, specification construction and documentation of artefacts of software systems
UNESCO: United Nations Educational, Scientific, and Cultural Organization: an agency of the United Nations supporting programmes to promote education, media and communication, the arts, etc.
VHS: Video Home System, videocassette recording technology
Virtualization: creation of a virtual rather than actual instance of software or hardware (see also *emulation*)
VRML: Virtual Reality Modelling Language, file format for representing 3D graphics
W3C: World Wide Web Consortium
WF4EVER: Advanced Workflow Preservation Technologies for Enhanced Science, *EC*-funded project
WinUAE: Amiga emulator supporting 5.25" and 3.5" double density disks and 3,5" high density floppy disks
XML: Extensible Markup Language, a widely used format for encoding information

ISBN 978-1-86137-6312